THE FUTURE OF AGRICULTURE

DISCOVERY

A Monthly Popular Journal of Knowledge

Vol. X. No. 119. NOVEMBER, 1929. PRICE 1s. NET

"BOUND FOR THE MOON"!
(See page 369)

CHIEF CONTENTS.

DISCOVERY

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Trustees: Sir J. J. Thomson, O.M., F.R.S., Sir F. G. Kenyon, K.C.B., F.B.A., Professor A. C. Seward, Sc.D., F.R.S., Professor R. S. Conway, Litt.D., F.B.A.

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Editorial Notes.

No article so far published in our series on the Next Step in Science has been of more practical importance than the contribution this month from Sir John Russell. Agriculture is the oldest of the sciences, yet from some points of view the least developed, and at the same time it is probably the subject of more discussion irrelevant to its actual progress than any other subject. As Sir John admits at the outset of his article, most of the prophecies made about agriculture during the last century proved wrong in the light of subsequent events, and the wisest course is therefore to examine what should happen if present trends continue. In this connexion he dismisses at once the idea that schemes of a political rather than scientific nature are likely to be welcomed by the countryside. The fundamental problems are essentially technical, among which may be included greater organization in marketing. Broadly speaking, farming in England is now divided between two methods, the intensive and the extensive, by which future progress is likely to be governed. The former consists of specialization in the crops and cattle most suited to particular localities, though the character of agriculture in different parts of England is further determined by rainfall. A line from Berwick-on-Tweed to the Isle of Wight divides the wetter western area, devoted to grass cultivation, from the eastern counties which are mainly under the plough. As is to be expected, it is in these last districts that the new specialization is developing most rapidly, but equally in extensive farming changes are taking place, for example, in the altered public taste in regard to the size of meat joints. The weather must always remain the most fundamental factor in agriculture, though its uncertainty may be diminished if meteorologists can discover more about the conditions governing rainfall and can suggest practical ways to put this knowledge into effect.

* * * * *

We shall conclude the Next Step articles in December with the important subject of Engineering, and for the New Year a series has been planned which we think will be of even wider interest. The general title of the new articles is "The British Universities To-day," and they will embrace not only the ancient and modern universities here at home but also, we hope, some of the larger institutions in the Dominions. Further details will appear in December, meanwhile it may be explained that the articles will not be merely descriptive—that would hardly justify space in pages essentially devoted to discoveries and new points of view. Except in a few obvious cases where the future is so closely bound up with past traditions as to make some review necessary, the contributors will discuss mainly the governing policy of each university and will endeavour to estimate its most prominent contribution to modern life and progress.

* * * * *

In one of those extravagant statements for which Mr. Bernard Shaw is noted—the occasion was a ceremony at the University College of the South-West last month—he urged that "no citizens of Plymouth or anywhere else should be persuaded to send their sons to Oxford or Cambridge," but instead to the local universities, which had lost what he described as the "tone of these unvenerable institutions." Since he went on to say that Oxford and Cambridge should be "razed to the ground" Mr. Shaw cannot have expected to be taken seriously; but his remarks were indicative of an element of mutual misunderstanding which undoubtedly exists, and we hope the articles in *Discovery* will do something to dispel it. We suspect that the underlying ideal, though finding expression in many different forms, will be found much the same in

every university where our national traditions prevail.

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As we go to press the world's largest airship, the R 101, is engaged in a series of flying tests, and a first cruise over London has been followed by a long flight over the provinces. By reason of its size there is only a small clearance between the giant vessel and the roof of the hangar at Cardington, so that great care has to be taken in bringing it out to the mooring mast. Strong winds happened to prevail on the day announced for the first flight and prevented this operation, with the result that the newspapers were filled with adverse comments. It has, of course, yet to be seen whether the expenditure on the R 101 of a sum of public money said to amount to £3,000,000 is justified by the results. But all the preliminary reports are favourable, and those who have seen the airship cannot fail to be impressed by its workmanlike appearance. As we watched from the roof of Bouverie House, the offices of *Discovery*, and saw the giant vessel sail towards St. Paul's without the noise of the larger aeroplanes, we could only wish that more of these graceful vessels might take the place of their less silent relatives.

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For some years past we have published articles dealing with rocket flight, and another appears in this issue. Making the most of the opportunity to present a subject scientific in principle but decidedly amusing in practice, we have printed the many spectacular plans of the Austrian contributor, Max Valier. Now, however, a German rival has shown that the notion of flying in a rocket-driven aeroplane is not so impracticable after all. The effort was chiefly notable as showing amazing courage, but it followed logically on the record speed obtained with a rocket-driven car last spring. The idea that passengerless rockets might be used for a rapid postal service is of more immediate interest. If a method of guiding these missiles can be discovered, there seems no reason why they should not be made to land in a specific area. Writing in June, 1927, Herr Valier proposed in *Discovery* to send a passenger rocket to America in four hours, and now the theory is suggested that a thirty-minute postal service might be established over the Atlantic. This seems, to say the least, ambitious, yet only more remarkable was the solemnity with which the American Ambassador in Berlin received the idea. He is reported to have no objection in principle, provided that neither the lives nor the property of American citizens shall be endangered!

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One of our book reviews this month has an interesting story attaching to it. As soon as Mr. Eliot Howard's now well-known "Introduction to the Study of Bird Behaviour" reached this office, it was sent to Mr. E. M. Nicholson, who so often writes for us on ornithological matters. He had, however, just previously set out for British Guiana, there to study bird life with an expedition from Oxford led by Major Hingston. The book is a large one, but the parcel containing it was forwarded unopened, eventually reaching the camp in the tropical forest. Reading a book of general title but dealing with a corner of Worcestershire, Mr. Nicholson not surprisingly found himself asking how far its conclusions applied to the birds of a tropical forest, and in his review (on page 384) this interesting reflection is discussed. We receive letters and articles from all parts of the world, but we imagine that for a book to travel four thousand miles to "a muddy creek draining into the Essequibo"—as Mr. Nicholson describes his camp—and to be reviewed a month later in a London journal, is a unique experience in the annals of journalism.

* * * * *

A system of making and reproducing sound records which may be destined to supersede the old method employing discs or cylinders was demonstrated last month to *Discovery* by Mr. Louis Blattner, at the Blattner Colour and Sound Studios, Elstree. The new process is as follows. The sound waves are received on to a microphone, which converts the acoustic vibrations into electric vibrations which are conducted into the coils of small electro-magnets. Past the cores of these electro-magnets a thin steel tape or wire is made to pass at constant speed. The electric vibrations are recorded and fixed as magnetic vibrations on this tape. Reproduction is effected by the reverse process. The different magnetic values of the steel wire influence the small cores of the electro-magnet. This gives rise to current impulses which are conveyed to a loud-speaker.

* * * * *

Obviously this new method effects great economy of space and portability, in comparison with discs and cylinders, and enables records to be of almost unlimited length. Records giving three hours' continuous reproduction have already been used. They can be reproduced an infinite number of times and are almost indestructible, except by deliberate breaking. Perhaps the most interesting application of the invention demonstrated, was its use as a recorder of telephone conversations. A conversation was held through the Post Office exchange system, and immediately afterwards clearly heard again from the tape attached to the instrument.

The "Next Step."—XI.

The Future of Agriculture.

By Sir John Russell, D.Sc., F.R.S.

Director of the Rothamsted Experimental Station, Harpenden.

A progressive future is predicted for agriculture, provided that farmers follow the lines of scientific production most suited to their localities, and that meteorologists are able to discover more about the weather.

LOOKING back over the writings of the nineteenth century one finds a number of predictions about the future of agriculture, which while varying considerably among themselves have the one feature in common that they have mostly proved to be false. I shall adopt, therefore, the safer method of setting forth recent trends in agriculture, showing what kinds of problem are now important and what seem to be imminent if the present trends continue.

Refrigerator Transport.

The older agriculture which persisted from early times down to the latter part of the nineteenth century aimed at making each region self-supporting in essential foodstuffs and clothing materials; its products were wheat, barley, oats or rye for bread; barley for beer; meat; wool and hides. The system was partly improved during the nineteenth century and it grew into an intensive agriculture. It was, however, broken down by the opening up of new countries and the development of transport, which began in the last years of the nineteenth century and has continued steadily ever since. The present phase is the development of refrigerator transport and the setting up of low temperature research at the National Physical Laboratory, at Cambridge, and elsewhere. With this improved transport, lamb killed in New Zealand in March can be put on to English tables in June or even later in so good condition that the ordinary housewife cannot distinguish it from newly killed English lamb; many fruits (not yet all) can be carried from tropical countries; while grain can be transported great distances at a very low cost. As Great Britain has always adopted the policy of free trade and the open door for all agricultural products grown at home, the British farmer has had to sell against all comers, even against those who, favoured by bounteous harvests with an excess of crop, must either sell cheaply or waste their produce. Indeed, in recent years continental farmers in this position have been given bounties by their governments to enable them to sell in Britain below the cost of production.

Another important factor has been the widened scope for the young countryman. In the early part of the nineteenth century he was forced to work on the land: there were relatively few chances elsewhere. The farmer could, therefore, always rely on abundance of labour, much of it highly skilled in the processes of husbandry. Wages were low, hours were long, and holidays were very few. As the years passed, however, openings in the town offering better prospects and more variety in life became more and more numerous, and now a large proportion of country boys and girls sooner or later forsake the land; the residue is composed of two groups: those really keen on farming, and those who cannot get any other work, but the numbers are insufficient. There is thus a shortage of labour on the land which is intensified by the shortage of cottages; wages have gone up, hours have gone down, and while the standard of craftsmanship is probably lower than it was, the cost of a unit of work has certainly increased.

Specialization.

These two difficulties—intense competition from abroad, forcing down prices of produce, and increased cost per unit of work, forcing up costs of production—have had the result of restricting the farmer's operations to the production of those things that are easiest for him and best for his farm. He no longer aims at making the local community self-supporting, he has dropped the difficult and uncertain items out of the old programme and produces only those things to which his farm is specially adapted. In other words, he has become a specialist.

In Great Britain specialization has been applied in two different ways. Some farmers have cut down expenditure to the very minimum: reducing the number of farm workers and so lowering labour costs, gross output and also return per acre, but doing it intelligently so that they increase their monetary return per pound spent and the output per man hour. This method reduces the wealth of the countryside, but it gives a living to the farmer and the surviving

workers. Other farmers have increased the output from the land so much as to pay for the extra cost of labour and at the same time to permit of sale at the low prices prevailing.

On *a priori* grounds the second method is much the better: certainly it suits the community better and it fosters the pleasant thought, dear to the hearts of the townsmen, that the unwanted people of the town might be placed in the country and so cease to be a burden on the taxpayer. Unfortunately the method is not always successful, frequently it has led to disastrous results; but there have been many instances of success, and usually this has come when farmers have broken away from the old plan of producing everything and have specialized in some one or more directions for which their farm, their markets, or they themselves, were particularly well suited. This specialization has had the further advantage that it makes the farmer an expert, able to understand and utilize the services of scientific experts, and able also to market his goods to better advantage than the more general farmer.

So far as the farmer is concerned, either method may succeed. The first is much the safer, the second is attended with risks but the reward of success is greater. It is largely a question of the temperament of the individual, and in the same districts one finds men practising both methods side by side: the "extensive" farmer risking little, employing few men, producing little per acre, a rancher rather than a farmer, but multiplying his acres so that his total gains become respectable, always, however, putting Safety First; and the "intensive" farmer, spending much, risking much, employing many workers, getting much produce out of the land, sometimes doing well, but in any season liable to lose almost everything.

Risk or Safety First?

The difficulty about predicting the course of British agriculture is that one cannot say whether the spirit of Safety First or of risk will prevail among our countrymen. We may dismiss at once any idea of State intervention, political pressure or compulsory intensification: measures of this kind would stiffen the backs and awaken the obstinacy of the whole countryside—and few townspeople realize how much obstinacy there is on the land! The only methods acceptable in the countryside would be subventions to intensive farmers, and State farming with guaranteed wages and salaries to all concerned, the losses naturally to be borne by the taxpayers in the towns. Putting all this aside it is much more probable that both methods will continue since both types of men—cautious and adventurous—will always be found in the countryside.

In England the main division of specialization is determined by rainfall. A line drawn from Berwick-on-Tweed to the Isle of Wight divides the country into two portions, in the eastern one the rainfall is on the whole less than thirty inches per annum and in the western (excepting the Cheshire and North Shropshire plains) it is more. Under high rainfall arable cultivation is difficult and grass cultivation easy: in the western part, therefore, grass has extended and arable cultivation has shrunk; in the eastern part grass cultivation is on present knowledge more difficult than arable cultivation, which has, therefore, survived in spite of severe economic depression. In Lincolnshire indeed it is increasing: the area of arable land increases at the expense of the grass, while in Norfolk seventy-five per cent of the land is in arable cultivation. In other eastern counties, however, it is less, being about sixty per cent.

Intensive Production.

The specialization in South Lincolnshire has been towards potato growing. In the olden days, as elsewhere, there was much general non-specialized farming on the arable land and beef production on the grass land. There have always been potatoes grown here but the old sorts were liable to disease, especially in wet seasons. The discovery by Mr. Clark of the disease resistant variety known as *Magnum bonum*, and its commercial development by Messrs. Sutton from 1876 onwards, enabled James Thompson and William Dennis to start a new potato-growing industry which has steadily developed and is now one of the most intensive of its kind in the world. Varieties and methods have been improved, the aid of science is freely involved, and everything possible to develop the industry is done by the best of the growers. The ordinary, non-specialized farming has almost gone, the bullock pastures are broken up, and no less than one-third of the whole of the arable land is devoted to potatoes. Other examples of specialization are found in Norfolk, formerly the main home of general farming. Cattle were fattened in yards during the winter and the great fat stock at Smithfield just before Christmas was largely a Norfolk holiday. Sheep were fattened on the arable land; wheat and barley were produced; great maltings and breweries developed. Much of this still remains, cereals and meat being still the chief products of the county, but the individual farmers are specializing. Those on light land are producing barley and sugar beet; those on heavy land, wheat and meat. But a new

form of specialization is coming in: Norfolk is becoming an important fruit county. Already it stands second only to Kent in the production of strawberries, currants and gooseberries: apples are increasing and along with them goes cider making.

If space permitted one could enlarge on the intense specialization which has now developed in Kent, and in the Evesham district where the production in fruit and market garden produce has become a fine art. In the Lea Valley just north of London, in the Waltham Cross and Cheshunt regions and beyond, there is perhaps the most highly specialized and intensively cultivated district in the world: an area of more than a thousand acres under glass devoted to tomatoes and cucumbers producing on an average something like £15,000 or £20,000 worth of crop per acre. Under the old system of general farming the produce was worth about £10 per acre.

The Extensive Method.

At the other extreme are the men who practise extensive farming, spending little, losing little and gaining little, but nevertheless contriving to get a living for themselves and a few workers, but these also specialize and produce only those things that can be got easily and cheaply in the conditions in which they are working. Instances can be found on the chalk areas of the South of England. Formerly this land was intensively farmed, producing mutton, wool, wheat and barley. Under the system of extensive farming the production per farm is much less. These "extensive" farmers have given up the wheat and barley and confine themselves to mutton and wool, the output of which, however, is much reduced because the land has gone down to grass. The old Southdown sheep did not like the change, and they are going too, being replaced by breeds and cross-breeds that are happier in the new conditions. A further change is the result of altered public tastes: big joints of fat mutton are no longer wanted, the demand is for small joints, not too fat, tender and therefore young; in consequence the modern sheep does not live as long as its predecessor of forty years ago. To meet this change the farmer has produced new types of cross-breds bearing a large proportion of twins that will grow rapidly to the size, shape and degree of fatness desired by the British housewife.

It is not only in England that this great change in agriculture has come. These same two factors that have operated here with such marked results, improved transport and higher labour costs, have operated all over the world. Their effect has been least felt in peasant countries where the farm is a family holding furnishing all or most of the food and clothing for the family, only the excess above these requirements being converted into cash. The greatest effect has been produced in countries having a high standard of living, where the cultivators are not content with the narrow range of products obtainable on an individual farm but require others obtainable only with money. The countries affected are Great Britain, Northern Europe, the self-governing Dominions of the British Empire and the United States. Most countries except Great Britain have tried to mitigate the bad effects to the farmer by some kind of protection or some adjustments on transport and other charges, and even in Great Britain agricultural land has been de-rated and a subsidy has been given for the starting of the sugar beet industry. Whether much or little has been done in these directions the effect has been the development of specialization at least as much as in England. The accompaniments of the specialization here varied: in Northern Europe it has been accompanied by intensification; in the newer countries of high labour charges, by a remarkable development of labour-saving machinery; nowhere, however, has there been the movement from a more intense to a less intense farming as seen in parts of England.

Some Comparisons.

The intensification of Danish farming has been ably discussed in a recent paper by Harald Faber.* He shows what the output of food per unit area from Danish farms has been in comparison with farms of Great Britain:—

MILLIONS OF FOOD UNITS PER HECTARE.

	England and Wales.	Scotland.	Denmark.
1889-1893	23.5	22.9	16.1
1899-1903	23.8	22.8	19.3
1909-1913	24.6	24.2	25.4
1923-1927	24.3	24.4	30.6

In the overseas Dominions and the United States labour saving machinery plays a great and increasing part. The modern Empire farmer works under very different conditions from those of the old pioneer. His implements are often highly efficient: compare for example the day's work of a wheat grower in Western Australia with that of a wheat grower in England:—

	WESTERN AUSTRALIA.	ENGLAND.
Ploughing	5-6	1 Acres per day.
Cultivating	20	6-8 ,, ,,
Sowing	25	8-10 ,, ,,

*"A New Method of Comparing the Productivity of Crops on Arable Land in England and Wales, Scotland and Denmark," *Journal of the Royal Statistical Society*, 1929, *p.* 559.

The difference in result does not mean that the Western Australian is the better farmer; indeed, as a farmer he is not so good, but his conditions, large level fields and wide roads allow him to use implements designed and made in Canada and the United States, but unsuited as a rule to our conditions. The comparison shows, however, that we still have a long way to go in England in designing implements that can do for our farmers what the Canadian and American makers have done for theirs.

Empire Production.

In the Empire, labour-saving machinery has been applied mainly to wheat growing. Specialization has proceeded in other directions which, as in England, are determined largely by rainfall. New Zealand with its moist, cool climate has given up wheat for grass and specializes in milk and lamb, the milk being mainly converted into butter. In the moist sea coast regions of Canada, Australia and South Africa, there has been much specialization in dairying (the milking being done by machinery, not by hand except for the final "stripping") and in production of deciduous fruits—apples, pears, apricots, etc. In the drier inland regions wheat production has developed in Canada and Australia, and maize production in South Africa. In still drier regions cattle are produced in Canada, and sheep for wool in South Africa and Australia.

Where irrigation is possible fruit is grown, or alternatively fodder crops, usually lucerne for dairying. The fruit depends on the local conditions. In Australia and South Africa it may be citrus, expecially oranges for summer consumption—a new taste in England; or vines to make into raisins or wine; as transport improves more will come over as table grapes. In both countries and in Canada the growth of peaches, apricots and other fruit for canning is extending. All these industries are specialized: none of the growers correspond in the smallest degree to the old type of British farmer who was equally at home with wheat, barley, sheep, pigs, cattle and half a dozen other products.

It seems reasonable to expect that specialization and the use of labour-saving machinery will continue to increase in agriculture: and the expectation seems so good that a great deal of the scientific work is being shaped in accordance therewith. Specialization has the advantage that it enables the farmer to become an expert at his job; it facilitates combined action in buying and selling, which in these days of organized business is absolutely essential; and it enables the farmer to utilize the resources of science. For the scientific worker specialization means close adaption of crops to environment: the scientific problems are those associated with the relationships between plant growth, soil conditions including supply of nutrients, and climatic conditions.

Supply of nutrients is controlled by means of fertilizers. The art of cultivation—now gradually being reduced to a science—allows the control of air supply and to some extent water supply and temperature to the plant root. The reaction of the soil—whether slightly acid, slightly alkaline or neutral—is controlled by additions of lime or sulphur. In dry regions irrigation adds to the water supply, though it also concentrates into streaks and patches the salt which, in arid climates, is distributed throughout the soil, making the areas barren. All these problems are capable of statement as scientific problems amenable to investigation by the ordinary methods of science.

The adaptation of crop to environment is effected not only by changes in environment but by changes in crop also: plant breeders are continuously bringing in new varieties of crops, and stock breeders are introducing new crosses among breeds of animals, the new forms in each case being more suitable to the surroundings, more acceptable in the markets, more resistant to diseases or in other ways more acceptable than the old. Further, the scientific worker is gradually achieving some measure of control over plant and animal diseases and pests. Losses from these are always unwelcome, sometimes they are serious.

The Weather Problem.

Finally, attempts are now being made to conquer the weather which, in the past, has dominated the farmers' activities. The constant factor of climate can already in part be overcome: dryness by irrigation; coldness, as in Northern Canada, by breeding varieties of plants requiring less time to complete their maturation. Even the variable factors of weather look as if they may in time be controlled to some extent. Modern statistical analysis as developed at Rothamsted shows the relationship between weather and fertilizer efficiency. If the general character of the season could be predicted, appropriate fertilizer recipes could be given to farmers enabling them to take full advantage of the good features and to mitigate the bad effects of the harmful ones.

Can meteorologists even make this prediction? If so, a great step forward in agriculture can be achieved.

An Unsolved Mystery of the Pacific.

By J. P. Ault.

Commander of the Research Ship "Carnegie."

Concluding from the October issue his log of the voyage from Balbao to Peru, Commander Ault first describes a visit to the mysterious Easter Island in the Pacific, at which the "Carnegie" anchored for some days.

We sighted the famous and mysterious Easter Island on the morning of 6th December, 1928. It lies in the southern Pacific about 2,000 miles from Chili, to which it was annexed in 1888. In its small area 555 statues, some of colossal size, cut out of lava, are found. In addition the island contains platforms of masonry from 200 to 300 feet long; stone houses over 100 feet long with walls six feet thick built like forts; and tablets curiously inscribed with hieroglyphics. The statues, ranging from three to seventy feet in length, are in various stages of construction, some finished, others nearly completed, and others just commenced. Appearances indicate that work was suddenly arrested, but the traditions are silent upon the subject. The images represent the human body only from the head to the hips, where they are cut off squarely to afford a suitable base. The conjecture has been made that they were designed to represent distinguished persons and intended as monuments to preserve their memory. However, as no one knows who carved them or can be sure of the purpose, the island has been called the "unsolved mystery of the Pacific."

Ancient Graveyards.

The most recent book describing the island and its history is "The Riddle of the Pacific," by J. McMillan Brown. The several hundred images still stand or lie about in confusion over the sides of the mountain from which they were carved or over the image platform and graveyards which line the coast. Apparently Easter Island was chosen as the graveyard for the chiefs of a large island archipelago which suddenly disappeared. The thousands of slaves, who were kept at work carving out these images, were left without food and fell upon each other until only a few remained. The story of all these events was never recorded, and can be read only by reference.

We were welcomed and guided to the anchorage of Cook Bay by the entire male population or all who could get into the few boats. The governor came out with the Chilean flag flying, and all seemed delighted to see some new faces. It had been six months since the island had had a visitor. We lowered our dinghy with its eight-horsepower motor and sped ashore to arrange with Mr. Edmunds, the manager of the ranch, for fresh supplies of meat, vegetables and fruit, and to have our laundry done. We stayed for lunch and enjoyed fresh roast mutton, lettuce, cucumbers and bananas.

A Modern Ranch.

The next day we all took to horses and rode eight miles to see the images. Several of the party had never mounted a horse before, so they decided to walk for the last five miles. As Mr. Edmunds had let me have his horse and saddle I was comfortably mounted, but the native saddles usually consisted of a piece of sheepskin. Some of the horses had ridge-pole backs which is the reason that some of the party found it more comfortable to walk than to ride. And it rained nearly all day. Once or twice we sought shelter beneath the overhanging branches of a group of fig trees. Here we partook generously of the fruit which was ripening. We had lunch under the shelter of an overhanging ledge left where a huge image had been carved out. From this point we could see images in every direction, in every position, and in all stages of completion, mute testimony to the sudden cessation of all work by the slaves who were doing the carving.

We visited the ranch of the two Scotchmen who have charge of the 35,000 head of sheep with which the island is stocked. We dug into some of the ancient graves, merely heaps of stones, and brought up some of those curiously-carved skulls of the ancient chiefs who had been buried here. Seiwell had a fight with two hawks that had adopted the image mountain as their home, and who resented our intrusion. They swooped down to within a few inches of his head. The Scotchmen blamed all our bad luck, rain, and hawk fights, on our having disturbed the slumbers of the ancients in their stony sepulchres.

Paul and Seiwell towed a silk net in the lake which fills the crater of this mountain, hoping for some rare biological specimens from this isolated body of water. Paul had to wade through the water waist deep to get past the high growth of rushes along the edge.

We had three native boys to carry cameras and lunch, and when we returned on board we paid them with sugar and an old coat. Money is of little use on the island. The inhabitants prefer flour, sugar, clothing, soap, and especially lacking now were needles and thread. Anyone with a pair of black trousers could have had anything on the island were he willing to part with them.

Here we again carried out simultaneous observations of electric potential-gradient on ship and on shore, using the two recording instruments, keeping them going night and day for three days. We carried out also thirteen hours of continuous readings for daily changes in magnetic declination, horizontal intensity, and inclination. The tents were usually surrounded in the daytime by a crowd of natives, curious as to what the stranger visitors were doing, and watching for an occasional cigarette. The young folks gave us samples of group singing; the songs were the same as those we had heard so often in Samoa, Hawaii and Tahiti.

Our old guide of a previous voyage in 1915, Juan Taparo, was there and remembered us, as also was the old Italian. The boy Indio, now grown into a bright young man, did not remember us. In general, there was a decided improvement in the dress of the people and in their manner of living. Many are growing sweet potatoes and corn, and are raising sheep and cattle. They are learning that a little labour will add much to their comfort and to their supply of food. The island is much improved in appearance. Fences have been built dividing the entire pasturage into several paddocks for grazing and breeding purposes, and the ranching is being done on modern methods, with trained shepherds. Eucalyptus trees are being planted each year and are doing well. Bananas grow in abundance, and for over a month after sailing we were eating from the many bunches hanging about the decks.

Medical Clinics.

The ship's doctor held several clinics, treating the natives for various complaints, mostly rheumatism, injuries from horseback accidents, and stomach-ache. The governor's wife, a native woman, teaches the school, and a priest comes out from the mainland once a year to care for the religious life of the village. The people are poor but they are reasonably happy, not too busy, live in a very fine climate, and seem to get along very well together. The most severe punishment, dealt out for robbery which seems to be the chief crime, is to sentence the guilty person to work in the garden for a day. I should much prefer capital punishment myself!

For our observations we had to make the tents absolutely mosquito proof, during the day as well as during the night, and the flies even out at the anchorage were a real plague. We wandered around the village, admiring the profusion of flowers in the front yards, gorgeous geraniums, snap-dragons larger than we had seen at home, hollyhocks, and others of the old-fashioned but beautiful flowers we have known so well; chatting in Spanish with the natives; trading wearing apparel for small stone images, old stone fish-hooks, and marvellously carved grotesque wooden images.

A Farewell Picnic.

On 12th December all work had been completed, the instruments had been brought on board, and we were planning to have a farewell picnic and feast with the Easter Island natives, when suddenly, about 10.30 in the morning, we found the vessel adrift and moving slowly toward the rocks along the shore. The manila hawser used for anchor chain had parted, due to wear against the hard sand and coral bottom, and the 1,900-pound bronze anchor was lost. The buoy, usually attached to the anchor with a strong line had disappeared while we were working on shore and had not been reported. We immediately let go the lighter port anchor, in the meantime getting the engine started, but continued to drift. As this anchor did not take hold on the bottom we heaved up both cables and the port anchor, and stood out to safety under power.

We then decided to sail for Callao, without trying to find the lost anchor, rather than risk the vessel in such close proximity to the rocks without sufficient anchors. So we sent word ashore to Mr. Edmunds to kill the sheep and bullock and send them on board as soon as possible. We sent him some cases of canned pears, his favourite fruit, in payment for all the fresh meat supplied during our stay. In the meantime the vessel stood out to sea and back again under easy sail and engine power, until at 3 p.m. we sighted our brave little dinghy and her crew ploughing through the white caps toward us, throwing the spray high and wetting all on board.

Two sheep, half a bullock, bunches of green bananas, and fifty live chickens were hoisted on board, and we sailed away regretting our lost anchor and shortened stay, but thankful that our vessel was not pounding her life out on the jagged black rocks which line the shore. Easter Island is a graveyard for anchors as well as for ancients, as many vessels have shared our bad luck, some drifting ashore and being completely broken up. Our Scotch friend has been vindicated. The ancient ones have taken their toll.

We ate the last of the bananas over four weeks after we left Easter Island, we had the last of the beefsteak for Christmas lunch, and ate all fifty of the chickens for Christmas dinner. Two small Easter Island kittens added much diversion by their playful pranks, and by their effect on the ship's cat.

Continuing the voyage, we had the usual run of good and bad luck. Head winds drove us three hundred miles out of our course, to the south. We reached 40° S. before we were able to head up on our course for Callao.

On 8th January, 1929, the new shot-gun for measuring ocean depths was out of order for the usual 8 a.m. sounding. At 10.30, when repairs had been made, a sounding gave a depth of 4,700 feet, as against 13,000 feet obtained the night before, and as indicated on the chart. At noon the depth was 3,900 feet by shot-gun, so I gave orders to stop the vessel and send down a bottom-sampler on the piano wire, and occupy an ocean-station. A water-bottle, with protected and unprotected thermometers, was lowered on this wire also, so as to measure the depth by pressure effect on the unprotected thermometer. The wire angle was 12°, which, from previous calibration of the metre-wheel, gave a depth of 3,900 feet. The pressure thermometer gave a depth of 3,800 feet, thus giving a close agreement between all three methods. The snapper brought up an excellent sample of greyish-white globigerina ooze.

Thus we discovered a new submerged mountain ridge, ten miles across and about 10,000 feet higher than the surrounding ocean bed. Soundings were made at intervals of two hours during the afternoon. The ridge fell away very rapidly until at thirty-two miles distance the depth was again well over 13,000 feet. This ridge, named Merriam ridge in honour of Dr. John Merriam, President of Carnegie Institution of Washington, is probably an extension to the northward of the ridge which breaks through the surface at San Felix and San Ambrosio Islands. It is about six hundred miles north-west of Valparaiso, Chile.

A GIANT HEAD.
The statues on Easter Island represent only the upper part of the human figure and were therefore probably burial monuments.

MORE WEIRD STATUES.
The size of the heads in this photograph can be gauged by comparison with the horse seen in the centre.

We had been searching for Podesta Island about one week earlier, an island marked "Existence Doubtful" on the chart, sighted about sixty years ago but not seen since, though several efforts have been made to find it. Soundings near its reported position gave only slightly smaller depths than usual. We passed within two miles of the spot, with good visibility and nothing in sight. There are many such islands, reefs and rocks in the Pacific Ocean, and it would take several years for an expedition, fitted with a depth-finder, to search out all these doubtful places and remove them from the charts.

After we entered the region of the south-east trade-winds we made good progress towards Callao. It was very cloudy during the last five days, and on the morning of our arrival, we had some difficulty in persuading the stars to peep out long enough to secure observations for latitude and longitude, so that we could take good aim for San Lorenzo Island. Finally Regal and Arcturus consented to appear for brief intervals between cloud-curtains, old friends who know when and where to stand and how much light to put on.

The ship's cat stood with his feet on the rail sniffing the air and smelling land. The air was filled with birds. One dip of the hand-net brought up enough small fish for lunch for all hands, and so we knew that our long cruise from Balboa was nearing its close. We anchored in Callao Bay on 14th January, 1929, about ten days behind our schedule.

Television Enters Public Life.

By John L. Baird.

In April, 1925, Mr. Baird first announced in DISCOVERY *his achievement of television. The Editor recommended support for the new invention. To-day, when experimental broadcasting has just begun, Mr. Baird again contributes to these columns the only article he has himself signed for some years past. Editorial comment is appended as before, describing a special demonstration.*

ON the 30th September for the first time a regular service of television commenced through the British Broadcasting Corporation, and although the service is still purely of an experimental nature, it marks the entry of television into public life.

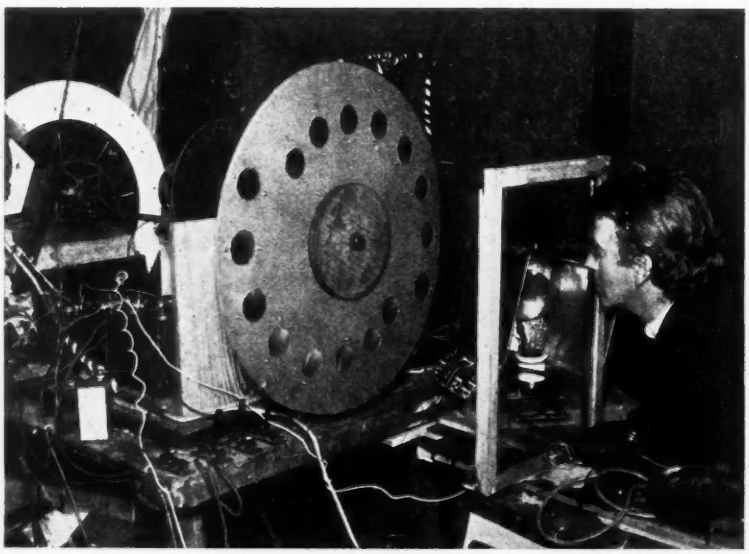
While there are few "televisors" available, and therefore few persons who can look in as well as listen in, anyone possessing a wireless set who cares to tune-in to 2LO between the hours of 11 and 11.30 a.m. could hear the television transmission—the introductory remarks of the announcer, followed by the peculiar droning hum of the televised image.

There is no difficulty whatsoever in sending out speech and vision simultaneously, providing two wave-lengths are available, and at our test transmission to the Post Office and B.B.C. early this year television and speech were thus broadcast, using the Station 2LO and the private station on Marconi House. But for the present transmission only one wave-length is available, and until Brookman's Park Station is completed this state of affairs will continue. In the meantime speech and vision can only be transmitted alternately, so that in our programmes the person who is to be televised first says a few words, and then is switched over to television for an image of his face to be sent out through the ether.

The sounds of television have an interest, and it is quite possible by listening to tell the difference between a face and a hand, or even to tell whether the subject being televised is in profile or full face.

In our laboratory some two years ago, while the novelty of hearing faces was still fresh, we carried out a series of tests, and found that it was possible to distinguish, by the sense of hearing, one face from another. A hand and a face can be very easily distinguished, and, although there is no music in these strange noises, when heard for the first time there is an interest in listening to faces.

With the public broadcasting of television now in operation, televisors will soon be available, and the general public given an opportunity of participating in the development of this new branch of science.



MR. BAIRD'S TELEVISION TRANSMITTER IN 1925.

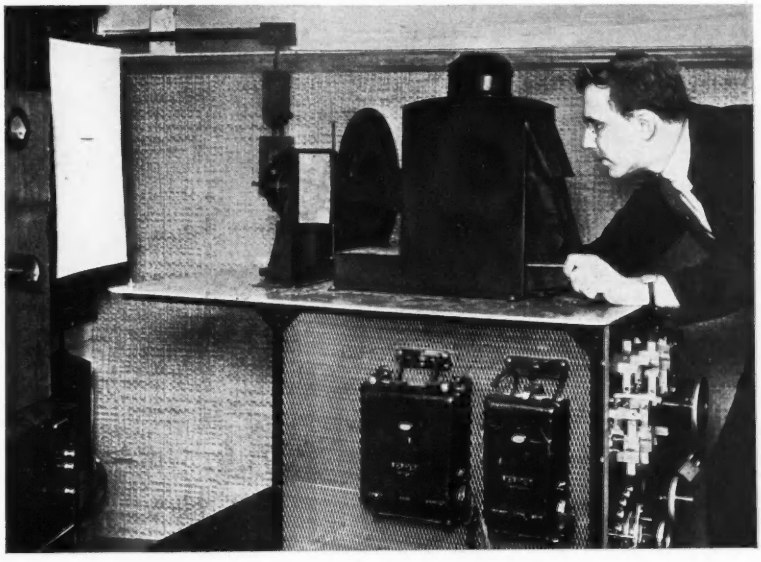
This photograph, reproduced from *Discovery* of April, 1925, shows the inventor and his first apparatus. The contrast with the modern transmitter on the opposite page provides striking evidence of the progress achieved.

EDITORIAL REPORT.

Unlike certain successful people, Mr. Baird is still a man of few words. Readers of his first article published in *Discovery* four and a half years ago will recall the concise description with which the historic achievement of "seeing by wireless" was penned. Not only did Mr. Baird begin by acknowledging his debt to previous investigators of television, but he concluded by emphasizing the

very crude nature of his first results. As the article appeared at the time when he was endeavouring to secure financial support for the new invention, this characteristic was all the more commendable. To-day, after a long struggle with technical problems and even greater difficulty in obtaining official recognition, the same modesty is still observed in what he writes.

In 1925 it needed courage to predict early success for the Baird method of television. "Astonishingly crude" was the description applied to the machinery by the Editor at that time, Major Pollard, for in general it was built out of derelict odds and ends. The optical system was composed of bicycle lamp lenses, while the framework could only be termed "an unimpressive erection of old sugar boxes" and the electrical wiring "a nightmare cobweb of improvisations." That this was no exaggeration the accompanying photograph showed, and its reproduction to-day, side by side with a view of the modern apparatus, emphasizes the remarkable progress of less than five years.



THE NEW TRANSMITTER OF OCTOBER, 1929.

Part of the modern plant, showing the scanning disc through which light is played on to the object transmitted. General resemblance to the 1925 apparatus is also noticed in other mechanical parts. (*Discovery* photograph.)

On 10th October, 1929, the present Editor was able to inspect the first public service at work. Transmission is made from the Baird Television Laboratories in Long Acre, whence the artists' images travel by telephone wire to Savoy Hill and are broadcast through the usual channels. The wave-length used is 375 metres, the same as for speech and music, whereas, should the company be able to erect its own transmission station, a more desirable wave-length between 100 and 180 would probably be employed. Notwithstanding this limitation, it can be said at once that the image received by wireless to-day compares in standard with the results transmitted over a wire a year ago. In the studio, in one part of the building, the artist being televised sat in front of the screen, his image travelling through the transmitter to Savoy Hill by telephone wire as already stated. In another room, connected with a wireless aerial, was the reception apparatus, through which the announcer's voice was first forthcoming, followed shortly after by an image of his face.

It was not, however, until the experimental period was over that the improvement since we last saw a demonstration (in October, 1928) was most clearly emphasized. The transmitter was at that moment connected by wire to the receiver, on which the image had previously been observed by wireless (the principle being the same in both cases) and the same artist was televised direct from one room to another. Adverse comment has often been made on the "flickering" at present inseparable from the Baird method of television, but at a distance of about six feet from the receiving screen this disturbance was no longer noticeable. Possibly this was because the voice attracted one's attention, so that the observer was occupied in listening as well as with seeing; all the same, the movements of the speaker's lips were clearly synchronized with his words, and when a singer next appeared on the screen the result was still more effective. The song chosen was admittedly a sentimental one, but this enabled one to judge all the better how closely the change of facial expression corresponded with the words.

Quite as striking was a display of photographs and printed matter placed in front of the transmitting screen. Picture after picture of well-known people was transmitted in this way, and considerable detail observed. A year ago attention was attracted by the use of the televisor for observing a newspaper poster in this manner, and just as the outline image first obtained when a moving face was televised has now given way to a distinct image, so the crude poster

IN THE TELEVISION STUDIO.

On the right is seen the screen and lighting source above, by which the artist's face is scanned for television. Behind is the microphone for transmitting voice and musical accompaniment.

has been followed by the successful transmission of photographs. Comparatively small print also can now be seen through the Baird apparatus.

The primary object of television—which distinguishes it from photo-telegraphy—is to transmit images of moving persons and scenes while action is taking place. But this subsidiary use of the Baird apparatus for "Teleography," as the process has been termed, affords striking evidence of the technical advance already attained.

We are informed that larger scenes, such as boxing matches have been televised in the laboratory, although public transmission for some time to come will probably be confined to objects of head and shoulder size.

The first apparatus in 1925 reminded the Editor of the earliest rudimentary attempts to produce a cinematograph. In 1929 it is, perhaps, still early to expect that television will soon attain a position in modern life comparable to that of its older rival, but no one can question that when perfection is reached, the invention will play an even wider part. Seeing as well as hearing by telephone or wireless has unlimited scope. To take one example, the buyer of ladies' garments and hats will be able to inspect the latest Parisian models from his desk in London. The diplomat and financier, again, could hold discussion with colleagues in other towns, or abroad, taking advantage by television of the added confidence which seeing the speaker's face and gesture affords. From some points of view, as Major Pollard said in 1925, "it is a devastating outlook." For when the invention is applied to the ordinary telephone prevarication will be even more difficult than it is to-day !

Yet having seen how in the short space of three years the silent cinema film has been ousted by its talkative relative, we can safely conclude a similar development for wireless, in the reverse direction. The voice alone will no longer suffice.

Across Africa by Motor-Lorry.

By Faith Cope Morgan.

During the summer the author made a motor journey of more than seven thousand miles across Africa. As she admits in the following account (based on a lecture broadcast from London) "a woman doing a long motor trip in the Dark Continent was a novelty." But friends who predicted failure were mistaken.

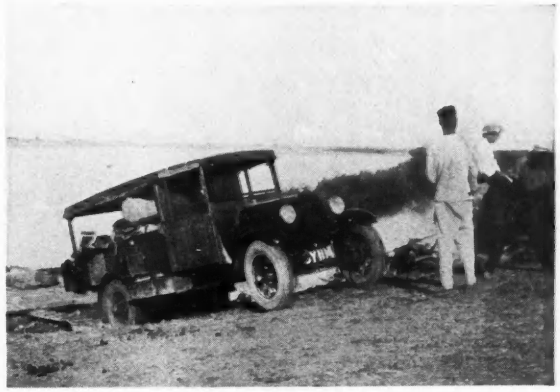
AFRICA described in one word is essentially the country of contrast. It can boast the civilization of the Egyptian and still descend to the extreme depths of cannibalism ; there are burning deserts and gigantic rivers, the malarial swamps of the west coast and the health-giving Paradise of the South. Rhinoceros, elephant, lion and game of all kinds provide an endless attraction for the hunter, while spirulum-tick and tsetse-fly bring blindness and paralysis, and sleeping-sickness in their train.

I had always wanted to see more of this fascinating country, and before leaving Nigeria we decided to try to motor across the continent to Kenya. A motor-trip to most people suggests a comfortable car, tarred roads and petrol pumps every few miles, with bed in a hotel at the end of each day's run. But the present journey was done in a lorry, 7,500 miles in Africa, with its vast spaces and execrable roads, where the traveller must be absolute "master of his fate" and the car have an "unconquerable soul." When our friends in Nigeria heard of our plan, everyone began to tell us that the season was too late, the rains would start, we would be marooned in the French Congo with no hope of getting help, the rivers would be flooded, or I would fall ill. A woman doing a long motor trip in the Dark Continent

was a novelty, and our friends took a gloomy view of my chances of getting through intact. The local doctor suggested that in addition to the usual tropical first-aid remedies we had better carry antidotes for snake-bites, mad-dogs and poisoned arrows, and I began to wonder what I was in for ! Then we realized the number of papers considered necessary for entering French and Belgian territories, and we could not help echoing Cecil Rhodes' longing for an Africa " All-Red." Among other things, each of us had to swear an affidavit that he had not been in prison—we carefully forebore to look at the boys when their turn came, for it was necessary to take two servants, a cook and a mechanic. The cook had been to East Africa from Nigeria during the war and said he understood Swaheli, so we enlisted him at once. A fracas with a shot-gun had left him minus some front teeth and he was very sensitive about the disfigurement ; when we got to Kenya, the East African natives did not disguise the fact that they regarded him as a cannibal, and the journey became for him a quest for two golden teeth.

My husband bought the lorry with a view to using her as a caravan and she was ready for all weathers, but at first it seemed quite impossible that she could carry all our necessities as well as four people, and when loaded up she looked like a jumble-sale on wheels. We had to travel entirely self-contained ; be ready to sleep in unfurnished rest-houses or in

MAP OF THE AUTHOR'S JOURNEY.



" THE STOUT EFFORT."
The author's motor-lorry proved worthy of its nickname, for besides enduring the worst of roads it had to be continually ferried over rivers.

the car, or to put up our beds in the bush, and not expect a hotel until we reached Uganda, 2,000 miles away.

At last all was ready, and leaving Bukuru in Northern Nigeria we drove to Lake Chad on the borders of the desert and crossed the dried-up bed of the N'Gala River into French Equatorial Africa. Along the banks of this river we saw a wonderful amount of bird life ; pelican, stork and duck abounded as well as guinea-fowl by the hundreds on the roads. It was just before the break of the rains and the dryness and heat were almost unbearable. The sun, blazing down out of a hard blue sky, made the sandy track dance in the glare and miles ahead the mirage constantly reminded us of our thirst. As the temperature here was 120° in the shade by 3 p.m., our drinking water was always tepid, but even so it needed a lot of self-control to keep away from the water-bottle. Soon the country changed, and we left the few patches of burnt-up thorn for almost continuous orchard-bush, where roan antelope as large as polo ponies galloped to one side, monkeys sought available cover and chattered angrily as we hurtled past, and hartebeeste, bush-buck and warthog raced along in the bush, keeping pace with the lorry. She was in a bad plight, for the road was still sandy, and there was a following wind, and in the scorching sun she boiled continuously and the radiator needed filling every two miles. We had to beg water for her from the natives in every village we came to ; they would gather round, men, women and children, to gaze, laugh and wonder when we stopped for the night. They were obviously puzzled by my shorts, bush-shirt, sun-helmet and shingled hair, but when I spoke there were delighted shrieks of enlightenment—of my sex, not of the language. For they spoke neither French nor Hausa

A FERRY ON THE RIVER BOMOU.
Planks bolted across several canoes formed the ferry for many rivers, the lorry being placed at right angles. A wing and lamp are seen in the foreground.

and we had to resort to signs, much to the cook's disgust, who hated to see us " play wid dem Pagans."

For days at a time in this country we saw no sign of civilized life ; any serious car-trouble here would have been a catastrophe, or had the rains broken when they were due our chances of getting help would have been small. All through the French country there were endless rivers to be crossed by means of amazing ferries made of planks bolted to dug-out canoes ; none of these ferries were built for a car of our size and it was most alarming to see the canoes bob and settle in the water as they took our three-ton weight. Often we had to unload and make two journeys, and several times we saw a protesting swirl in the water as an enormous hippopotamus rose to the surface to see the reason of the turmoil.

In the Belgian Congo, the first thing we saw was an Official in a white uniform, immaculate despite the sweltering heat, and learnt that he was in charge of customs, agriculture, passports *and* roads. In most colonies, roads are considered a whole time job, and yet here in the Congo we found the best highways of any in our long trek. At Bambili, half-way through this country, we tried hard to buy a baby lion about two feet long, a delightful person with paws like muffled pin-cushions and a pathetic howl of utter boredom. Weeks afterwards we rejoiced that the owner had refused to part with him, as a large and rapidly growing lion in a hotel at Johannesburg or Cape Town would have been somewhat *de trop* ! We visited a school for wild elephants at a Government Farm where they are being taught to draw a plough and be useful, thus exploding the old idea that the African elephant is untrainable ; it takes about three months after capture for the elephant to answer to his name, and then he is taught to do small jobs. We met the school out for a walk in the bush and fed the baby with sweet potatoes, but were disappointed not to see also an okapi, that strange animal mid-way between a zebra and a giraffe which is only found in the jungles of the Congo.

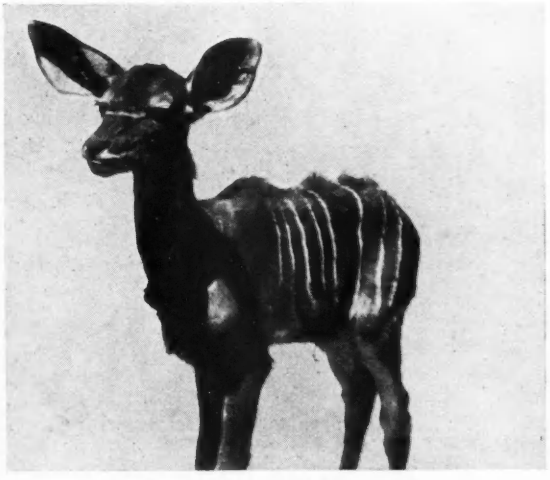
The boundary between the Belgian Congo and British Uganda is Lake Albert, and this we had to cross by a boat which sails only once a fortnight. Our luck nearly deserted us here, for on an escarpment which dropped 3,000 feet in seven miles and with only a few hours in which to catch the steamer, the transmission shaft broke, nearly causing complete disaster. Happily the brakes held, and four precious hours were spent on a roadside repair in the tropical noontide heat. A wild race against time brought us to the lake and our luck held, the boat was still there—so was the ice, and we had our first cool drink for nearly 2,000 miles. The next day, when we landed in Uganda, we rejoiced to pack away the French Dictionary and be on British soil again, though at first the roads did not make us realize this change.

Our way to Nairobi led across the Nile and then on through the great Rift Valley and past the Lakes Naivasha and Nakuru, sparkling like sapphires fringed with bright pink ; we thought there must be masses of water lilies until they got up and flew off, and then we realized they were flamingoes ! In spite of having to slow up on the extremely indifferent Kenya roads,

CROSSING THE LIMPOPO.
Through this boundary river between Rhodesia and the Transvaal, a team of twenty-four donkeys towed the car across the shallows.

we reached Nairobi twenty-four days after leaving our camp in Nigeria nearly 3,500 miles away; because of the bogey of overdue rains we had to hurry and had kept up a steady average of 150 miles a day. Our luck in the way of weather encouraged us to be really ambitious and try and reach the Cape, so after refitting we turned the car southwards for a further run of 4,000 miles. The boys were quite willing to go on, especially the cook; he had heard that in Durban there were *trams*—surely there must also be *teeth*?

The chief obstacle in motoring south was Tanganyika, formerly German East Africa, where we heard that the rains were at their height, one part of the country being under water. As our car could hardly be expected to behave as a motor-boat we planned a detour by means of train and lake steamer and then started to make for the railway at Dodoma. As a hint of what was in store the rains broke the night before we left Nairobi, and we had an appalling time getting out of Kenya. The roads became one continuous quagmire, and even with chains on the wheels we only travelled fifty-six miles in thirteen hours; the lorry had to be unloaded, dug out of the mud and pushed numberless times, while we were in the midst of more game than we could have seen in an afternoon at the Zoo. Families of giraffe, looking supremely ridiculous feeding off the tops of the trees, caused the Nigerian boys great excitement and they asked if they were "bush camels." Zebra, wildebeeste, hyaena, ostrich, kudu, warthog and all kinds of gazelle wandered about in this Reserve



BABY KUDU IN TANGANYIKA.
Many animals were photographed, and once a breakdown was mended among greater numbers than could be seen at the Zoo!

A SCHOOL FOR ELEPHANTS.
The author making friends with a young animal in the Belgian school for elephants, where they are trained to plough. An elephant will answer to its name.

absolutely confident of their safety; we had been promised rhinoceros who would probably charge us and the lorry on sight—as our average speed that day was about four miles an hour we were rather relieved they stayed away!

The Kudu or Koodoo, illustrated in the accompanying photograph, is the handsome African antelope. When full grown it stands about four and a half feet high and has spiral horns. The animal is distinguished by vertical white stripes on the sides of its gray brown coat, and there are also white markings on the head and neck.

From here we slithered and skidded along a trail blazed through the bush which was often difficult to pick up. Occasionally a herd of Masai cattle stared at us as we roared along, game melted into the shadows at our approach, and once we very nearly bagged a startled leopard which jumped from the bush right under our wheels. The next night we had a chapter of accidents. First, we stuck in the sandy bed of a river at sunset and had to unload; the hills above were half-hidden by rain clouds and little freshets each bigger than the last came rippling down and submerged the sandbanks, an ominous warning. Eventually a native village turned out *en masse* and carried the whole expedition ashore, looking like a large crumb in the grip of ants. Then, after the customary fight over the backsheesh, we were guided to a road whose bridges seemed to have given up the unequal struggle and one subsided altogether under

our weight. Some of the natives who had helped before, their blood now thoroughly up, followed hopefully and started to try and lift the car out, laughing, chattering and getting in each other's way. All bawled directions and no one obeyed, so we suggested the cook might try his powers as a linguist ; it sounded to us like a mixture of Hausa and English, and then came the inevitable wail, " These men no fit for hear my Swaheli."

Meanwhile, here we were, miles from a roof, our luggage spread over the bank, a mighty rainstorm coming up behind, working frantically in the darkness at the overturned car. We emerged after about two hours, reloaded and plunged on for another half mile, and then in the blinding rain we slid purposefully into a ditch where we remained sitting, cold and miserable, in the driving seats at an angle of 45° until dawn. Finally, we plunged through a sea of red mud into Dodoma on the Tanganyika Railway, and then had the joy of a hot bath, good dinner and a level bed in a comfortable hotel. We verified the fact that the country further south was impassable and then boarded the train for Kigoma on the shores of the lake, where at Ujiji we saw the extremely inadequate monument erected near the historic but decrepit mango tree under which Stanley and Livingstone met.

After five days on the boat we disembarked at the southern end of the lake, glad to be on the road again, and then started to explore Rhodesia " where every prospect pleases " and only *roads* are vile. I wish the lorry could tell this part of the story herself, for the going in these countries was almost unbelievably bad and the car lived nobly up to her baptismal name of the " Stout Effort." Grass, six feet high, disguised holes, tree stumps, rocks and other hazards, and we had to rig up a screen in front to keep seeds from choking the radiator. In the swampy places scrub and timber had been thrown down to form a corduroy surface, and over this we bumped and crawled in low gear, shaking our fist at an occasional notice board on a tree, labelling this horror " The great north road ! "

The African Night.

It began to get very cold at night and in the early morning, and we needed large fires both for warmth and as a guard against the odd lion. There were no rest-houses, and we used to camp by the side of the road and sleep under the stars ; the stillness of the wonderful African night, with the moon blazing like a jewel through the intensely dark blue sky, was almost oppressive, until broken by the absurd croaking of the bull-frog, the staccato buzz of the cicada, or the mournful howl of a distant hyaena.

Rhodesia gives the idea of indefinite space, with always a dim blue line of hills in the distance, and near at hand shimmering waves of wild grasses looking like a mauve sea. Sometimes we drove through shady aisles of Rhodesian teak where numberless small butterflies settled in clusters on the ground like a delicious pastel-hued carpet. Three miles from the Limpopo we prepared to camp in the playground of a score of lions, but being warned by a passing motorist we moved down to the banks of the river, and next morning at daybreak twenty-four donkeys laboriously towed us across the sandbanks and through the shallow water to the Transvaal shore. This side the road wound up and up through cool rock cuttings alongside a babbling stream, then down the far side of a mountain range to the brown open veldt dotted with farms and quaint Dutch Churches.

We spent two days in Johannesburg and expected the boys to be impressed by the size of this city, but the cook merely said, " This place be no good, I no fit to buy my teeth." We had seen him in one of the main streets, dressed in a flowing orange robe, war medals, a bright fez and an enormous pair of black boots, entering an optician's shop in mistake for a dentist !

Georgeous Flowers.

It is difficult to do justice in a few words to the Garden Route to the South, especially around Knysna and George ; mile after mile of magnificent, wooded, canyon-like country, with a road cut precipitously into and round the hills. It was winter and the country was not at its best, but when we had seen masses of plumbago in the hedges, the Arum lilies just coming into flower, the yellow, purple, pink and crimson heather, and the endless bushes of protea adding to the riot of colour—we understood why South Africa takes her wild flowers seriously.

Then we reached the shining rim of Table Bay, and " the most wonderful sea in the world," sapphires shading to forget-me-nots and then jade green on the reefs of mauve rocks ; we were forced to realize our journey was finished. To anyone tired of motoring in England, I suggest they should try Africa, and especially the South. Cape Province is perfection with its fine hills, its glorious sunsets, the attractive old Dutch houses and gardens ablaze with flowers, and girdling all the orchards and vineyards. We breathed a prayer that Rhodes' creed might always hold good, " I believe in a United States of South Africa, but—as a part of the British Empire."

The Moon Rocket Foreshadowed.

By John Andrews.

Concurrently with the first flight of a rocket-driven aeroplane, a cinema film was released in Germany called "The Woman on the Moon." The story pictures the dispatch of a giant rocket and the weird adventures of its passengers, and now the producers are financing the construction of an actual rocket aircraft.

FOLLOWING the successful flight of his first rocket aeroplane, the German inventor, Herr von Opel, at once set to work on larger experiments to achieve a record speed for rockets. The plan to fire a giant rocket off an island in the Baltic—discussed later in this article—was highly spectacular, yet as it merely tests the power of these projectiles, the aeroplane flight was the more interesting in regard to the possible transport of passengers.

A Cloud of Smoke.

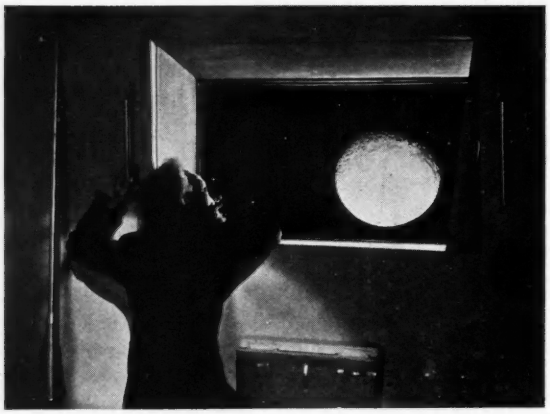
On 30th September the peaceful countryside near Berlin was disturbed by a machine flying over it in a cloud of smoke, but in spite of their noise the rockets carried the aeroplane for a distance of a mile. Not unnaturally the press reporters took the flight as a joke, and many of the public must also have agreed with their general conclusion. Thus after remarking on the highly original mentality which must have inspired Herr von Opel to submit himself to such a dangerous experiment, one writer suggested that no one could seriously contemplate travelling by this archaic form of power. That is obviously true, yet the conclusion was a limited one. It is just because rockets are designed for very different use that experiments are being pursued with them in a serious way. Rockets may be described as archaic in so far as their use dates back several thousand years in China, but it is by no means proved that for some purposes their principle may not be more efficient than that of the combustion engine.

Some inventors believe that the emission of gas under high pressure may provide much greater speeds than are obtainable from mechanical locomotion. Certainly no form of rotary engine is capable of penetrating the earth's atmosphere into space beyond, and there are those who think it possible that rockets can accomplish this end. Already experiments are being made to discover more about the conditions of the upper atmosphere by their aid, although of course, the ultimate idea is to reach the moon. Whether or not it might be possible for human beings to bridge the intervening space, it seems certain that conditions on the moon would be hostile to their survival, but that need not deter attempts to shoot at the planet. For however foolish the endeavour may be, it contains unmistakable elements of adventure. The moon is so readily observed from the earth that more is known about it than of any other heavenly body, and as our nearest neighbour it has always attracted man's imagination.

Most of the plans suggested for sending a rocket into space have commenced with its dispatch from some form of "gun," out of which the machine would be fired. But the design of the gun always presented great difficulties, which are no less real in rocket flight on a smaller scale. To those who have followed the history of the subject, therefore, the most interesting aspect of Herr von Opel's achievement was the method employed for launching his machine. "Taking off" has hitherto been the greatest obstacle to success. The essence of the problem is speed, and while there

BOUND FOR THE MOON!

Professor Manfeldt, a principal character in the new German film, at the steering wheel of his rocket-ship on its journey to the moon.



APPROACHING THE PLANET.
The Professor is watching from the cabin of the rocket in the course of its flight of thirty-six hours.

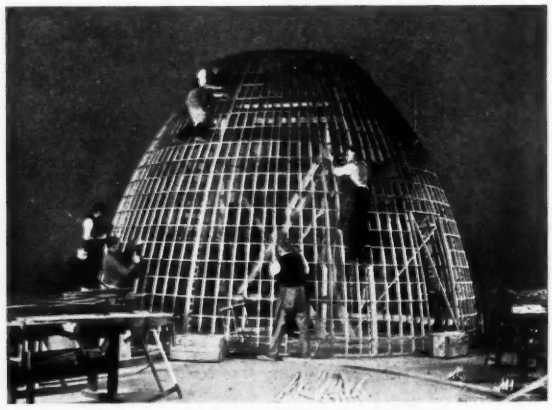
is apparently no limit to the rate at which the human body may travel at an even pace, sudden increases or jerks are not practicable beyond a certain point.

Before September 30th the Opel aeroplane had already been flown after an assisted start in the manner used for motorless aircraft, but on that date for the first time it was "shot" into the air. The Berlin correspondent of *The Times* reported that this was done in the following manner. A rail track thirty feet long was laid, with a buffer at one end. The aeroplane was placed on a starting trolley also propelled by rockets, which ran along the rails at great speed and discharged the aeroplane into the air as it struck against the buffer. At this moment the flight rockets were ignited by the pilot and the aeroplane proceeded under its own motive power. Braking rockets for firing in the reverse direction were also fitted, which were intended to reduce landing speed and so enable a slow landing to be made. This device, it is stated, has been used with engined aircraft and has given good results.

The first two attempts were unsuccessful. The trolley dashed along the track until it encountered the buffer, when it duly launched the aeroplane into the air. At this moment, however, the ignition of the flight rockets failed, so that the craft came to land. The ignition was overhauled, and a third attempt was made, this time with the desired result. The trolley made its dash, the aeroplane rose, the flight rockets ignited, and Herr von Opel disappeared in a deafening uproar and a cloud of smoke and flame. About a mile away the machine came to earth with what a spectator described as "a loud thud," and its dazed pilot emerged from the asbestos-covered cockpit.

Whether this dramatic end to the first flight might have been avoided by better construction only future experiment can decide. But it may be recalled that the rival machine proposed by Herr Valier in *Discovery* last May, for a flight over the Channel, was to be in appearance like a harpoon, fitted with folding wings which would be brought into play when the rocket fuel became exhausted. At the point of horizontal flight the wings would be first employed as stabilizers, next, the machine being empty of fuel and therefore much lighter, they would be opened out proportionately as the speed decreased. Landing would then be effected by a steady glide. In place of braking rockets fitted to the Opel machine, advantage would thus be taken of air resistance.

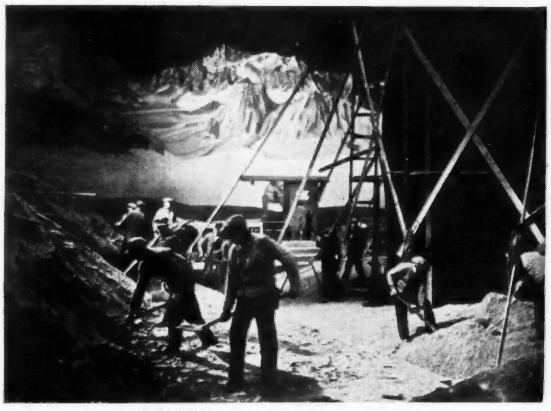
Now that a man has at last travelled through the air in a rocket, a comparison made a hundred years ago is not without interest. Ridiculing the locomotive in 1829, an English engineer asked what could be more palpably foolish and ridiculous than the proposal to build a locomotive with double the speed of a post-coach. "One can just as well," he wrote, "expect the citizen of Woolwich or Manchester to travel by a Congreve war rocket!" That was at the time when the far-sighted inventor, George Stevenson, named his first engine the "Rocket." Yet not until many years after the Congreve war rocket is forgotten, has the possibility of sending passengers in a rocket become an accomplished fact. Before the successful test of the Opel rocket aeroplane, however, the Austrian airman, Max Valier, had driven a car and also a toboggan with powder rockets, at a speed which was claimed to have beaten Sir Henry Segrave's world motor record by nearly twenty miles per hour. He is now experimenting with liquid fuels, the difficulties



BUILDING THE MOON ROCKET.
Workmen in the cinema workshops at Neubabelsberg engaged in making the rocket-ship, one of the many models necessary for the film.

of rocket propulsion being, in his opinion, a matter of fuel weight.

There is certainly widespread interest in rocket flight at the present time. Following the publication in 1923 of Professor Oberth's book, "By Rocket to the Planets," no fewer than seventeen books have appeared on the subject, several societies have been formed, and a prize for the study of the subject offered in France, of which the first award has been made to Professor Hermann Oberth. In Germany the prospects revealed in all this modern effort have caught the public fancy, and the cinematograph producers, quick to seize on a subject offering scope for pictorial fantasy, have spared no trouble in the production of a film entitled "The Woman on the Moon." This pretends to show the progress of a rocket vessel carrying travellers to that desolate sphere. It was composed under the scientific guidance of Professor



ANOTHER SCENE IS CONSTRUCTED.
Here many tons of sand are being shovelled in preparing the moon crater, on which the scene in another photograph was enacted.

Oberth, and the producers therefore claim that use has been made of available scientific data. For the purposes of the film, giant scenes were made depicting conditions on the moon, and a special "rocket ship" with a prow shaped like a torpedo was also constructed. The story shows how a young engineer named Halius and his friend Windegger work out the problem of the space ship, on the lines of a theory put forward by a Professor Manfeldt at an astronomical congress, that the moon could be reached and some gold deposits there mined with advantage. They agree to set out in their invention taking with them the Professor, and Windegger's fiancée, who plays the title rôle. A fifth passenger is an American from Chicago.

Before an excited crowd of spectators the rocket-ship starts on its expedition and in the first few minutes

EXPLORING THE MOON.
The rocket lands on the side of the planet hitherto unseen by human eye, where for the purposes of the film life-supporting conditions are assumed to exist.

disappears from sight. The film proceeds to show the resources used against abnormal pressure and gravitation, and conditions encountered in the upper regions. There are dramatic pictures showing the eager old Professor steering the ship through space or again watching the planet from its cabin as the machine speeds ahead. After flying for thirty-six hours the space-ship safely lands, but on the side of the moon never previously seen by the human eye. A theory that conditions supporting life are to be found in that region of the moon is then taken advantage of by the film producers, who also allow the travellers to discover there the Professor Manfeldt's mountain of gold. This discovery leads to jealous strife, and after various adventures in the terrible new land, the rocket-ship carries part of the adventurous crew back to earth, while the others remain to await the coming of a second machine.

By assuming the existence of special conditions on part of the moon, the need for artificial breathing has been overcome. Only a few photographs showing representative scenes from the film have so far reached London, but in the accompanying picture of a moon-crater, the explorer is not wearing any breathing apparatus. It would seem that an opportunity for adding to the fantasy of the story has thus been missed. It was formerly supposed that the moon possessed no atmosphere, but recent observations tend to show that the planet is surrounded by an atmosphere of a sort. The most convincing argument in view of this is the prolongation of the cusps of the new moon, which has often been observed, this being generally regarded as a twilight effect due to an atmosphere.

But what air there is on the moon must be of an extremely tenuous nature, not at all like our atmosphere, and it is certain that from the point of view of living beings, the moon is a dead world. Even if artificial means could be devised to enable human explorers to exist on the moon, it must also be remembered that they would be exposed during the lunar night to the terrible cold of outer space, compared to which our Arctic region would be regarded as mild. On the other hand, while life in any of its higher forms is evidently unknown, it is not impossible that some low form of life, such as moss or lichen, might grow on its rocky face, and this has prompted the highly speculative idea that large quantities of seeds might be shot at the moon in a rocket !

A Question of Power.

The success of the cinematograph film seems to have convinced its producers of possibilities in rocket flight, for they are now financing Professor Oberth in the construction of a rocket aircraft. They are proceeding on the lines that flight to another planet is a question of power, and have in view a machine capable of sufficient speed to rise above the attraction of the earth and its atmospheric resistance. The atmosphere of the earth extends perhaps a hundred miles upwards, but only the first ten miles or so is heavy enough to supply the necessary resistance for propeller craft. The planet ship must therefore have an engine capable of working effectively in the airless space beyond.

It was doubtless as a first step in proving the potentialities of rocket power that Herr von Opel invited representatives of the German Government and the press to witness an experiment at an early date. A small island off the Baltic coast, known as Greifswalder Oie, was selected as the site from which to fire a rocket over the sea. With the news of this event, a description was sent by *The Times* Berlin correspondent, to whom we are again indebted for details. The rocket (he reported) is some 30 ft. long and 18 in. in diameter. It consists of a double tube, the outer wall being of iron and the inner lining of copper, with a space between. It will be filled with liquid oxygen, in which four carbon rods will be placed. The burning of the rods generates the gases which provide the propulsive force. These stream out of holes in the underlip of the rocket's slightly bulbous head—it is approximately shell-shaped—at a speed of 1,500 metres a second. In order to adapt the pressure within the rocket to varying atmospheric pressures safety exhausts are provided. The head of the rocket is fitted with revolving steering fins and the tail with stabilizing fins. The nose contains a parachute, which it is hoped will unfold when the motive power is exhausted and bring the rocket gently back to earth. The projectile weighs about 143 lb. loaded.

As the rocket carried no recording instruments it was intended to observe its flight by telescopes, and to calculate trigonometrically the height attained. At the time of writing the test has yet to take place, but in view of its great speed, difficulty in determining exact figures was expected. Herr von Opel believes, however, that a rocket may soon be fitted with instruments—he has mentioned a camera in this connexion—and further that it should ultimately be possible to control the steering with exactitude. A rocket could thus be " landed at an appointed spot." However that may be, to reach the moon would require, with the fuels at present available, a volume of fuel out of all proportion to the weight of the machine, so that an efficient source of power must first be discovered.

Then, perhaps, if there are still investigators with sufficient imagination—or, as some would say, insanity —to make the attempt, the German film story may take more practical form.

London Bird Sanctuaries.

DURING recent years considerable progress has resulted from the recommendations of the Committee on Bird Sanctuaries in the Royal Parks. The grass has been allowed to grow long in certain plantations, and additional shrubs and undergrowth such as gorse and brambles have been planted, periodical thinning being carried out where necessary in order to prevent the growths becoming so thick as to exclude light and air or to hinder ground-searching by the birds. Nesting-boxes and nesting-material have been provided, seed is supplied in hoppers during hard weather, and vermin are kept down as far as practicable. Where possible, expert observers on behalf of the Committee have been appointed to take note of the bird-life in the various parks and to make annual reports. In other cases reports are made by the Superintendents.

In Hyde Park the large bank covering about an acre, round the frame-ground, has been formed into a sanctuary by allowing the grass and shrubs to grow freely and by providing suitable additional plants. The enclosure in Kensington Gardens on the east side of the Long Water was similarly treated. Subsequently the southern part of the Hyde Park sanctuary was enlarged, and ornamental pools, flanked by yew hedges, were formed there as part of the memorial to the great bird-lover, W. H. Hudson.

Science to Rescue the Whale.

Second " Discovery " Report.

The following extracts from the new report of the " Discovery " expedition deal with plans for placing the whaling industry on a scientific basis. The 1927-28 season in the Antarctic was exceptionally favourable for this research, and already steps are being taken to preserve the whale supply from indiscriminate hunting.

DURING the two years which have elapsed since the first report of the " Discovery " expedition appeared, much progress has been made in the problems under investigation in regard to whaling. Readers of the review printed in these columns for July, 1927, will recall that the " Discovery " had previously been acquired for research in the Falkland Islands, under the control of a committee appointed by the Colonial Secretary, and the latest account now issued* covers the work undertaken up to May, 1928. In addition to conducting a hydrographic survey of the region and its resources from the point of view of fisheries, the main purpose of the Committee is to make a serious attempt to place the whaling industry on a scientific basis. The cruises of the " Discovery " during this period are described in some detail in the report, but extracts will here be confined to the general conclusions.

A Record Season.

Fortunately, the 1927-28 season proved a momentous one for whaling in the Antarctic. Off the South Shetland Islands it was more successful than in any previous year. 5,500 whales were taken, and the yield of oil was over 66,000 tons, an increase in output of 47 per cent on the previous season, itself a season only once surpassed for output in the history of South Shetlands whaling. Moreover, the whales were taken by catchers working neither from shore stations nor from mother-ships anchored in the shelter of land, but from factory ships operating along the edge of the ice. Probably the success may have been due to climatic conditions which occur only from time to time, but its magnitude, coupled with the particular character of the whaling, resulted in an enormous expansion of whaling enterprise. The accompanying increase of catching power must inevitably modify profoundly the future of whaling and the problems attending its regulation, and some attention is given to this subject later in the report.

The most important work of the expedition is directed to finding a rational basis for the regulation of whaling. Whaling is the most important, almost the only industry of the Falkland Islands Dependencies. These territories furnish usually about 60 per cent of the world's supply of whale oil (for which there is a firm demand in soap making, margarine and other industries), as well as yielding a valuable export of whale meal and fertilizer. During the season 1927-28 their output of oil was over 134,000 tons, and as the price of the oil is from £28 to £30 per ton, the value was considerable. It is therefore clearly desirable to determine the intensity with which the industry can be prosecuted without detriment to future supply. Unfortunately, the past history of whaling gives every reason to fear that unrestricted whaling would lead not merely to a decline but to a complete collapse of the operations. The policy of the Government accordingly has been the conservative one of restricting whaling approximately to its present dimensions, while energetically searching for a basis for a definite conclusion as to the maximum intensity of whaling desirable. This policy was carried out by the limitation of whaling licences and the institution of the " Discovery " investigations.

The report points out that the problem reduces itself to discovering what number of whales of each species can be taken annually, without so depleting the stock that a progressive decline in abundance is caused which ultimately must make whaling commercially impracticable.

Distribution of Species.

One of the first necessities is to determine with what whales the operations in the Dependencies deal. The effect of a given intensity of destruction in that area will evidently depend on whether the stock attacked is, for instance, the same as that pursued on the African coast and other whaling grounds, or is part of a great stock that is but little attacked elsewhere. Systematic enquiry into the structure of the whales taken, and comparison of these animals with similar whales taken elsewhere are therefore necessary. Equally important is the determination of growth rate, of age and size at maturity, and of the birth rate, since from these studies light is cast on

* " Discovery " Investigations, Second Annual Report. (H.M. Stationery Office. September, 1929. 1s.).

the rate of recuperation of the species. Work on all these lines has been pressed forward at the Marine Biological Station, and comparison with the whales taken in other areas has been made possible by similar investigations at the whaling stations of Saldanha Bay and Durban, and in whaling vessels on the South Sandwich and Deception Island grounds.

The importance of the study of the distribution and migration of the whales also lies in its bearing on the same question, namely, that of the stock affected by whaling.

It should be borne in mind, the report continues, that two views as to whale stock in the South have been advanced. One is that there is one vast circumpolar stock, which, except in the course of northerly migrations, occupies the whole Southern Ocean with an abundance which if not uniform is at least everywhere considerable. The other view is that the distribution is extremely irregular, whales being abundant in certain areas only. The cruises of the "Discovery," extending from South Africa to Cape Horn, and from Tristan da Cunha to the ice edge, have contributed to the solution of this question directly, and still more indirectly by a study of whale food. The whales when in the South are feeding, and their distribution is necessarily governed largely by that of the small creatures on which they feed, as is discussed in a later section of the report. It follows that if large tracts are found in which these creatures are absent or scarce, no accumulation of whales can be expected. Investigations have been made, therefore, both at the whaling stations as to the exact species eaten by the whales and at sea as to the distribution of these creatures. Direct evidence as to migration is sought by marking whales with numbered darts, which when returned from whaling stations (a small reward is offered) will show the course travelled. These darts, shot from a shoulder gun, are used from the Research Ship "William Scoresby," which accompanied the "Discovery" on its voyage, and whose design enables her to make the necessary approach to within striking distance of the whale.

Difficult Problems.

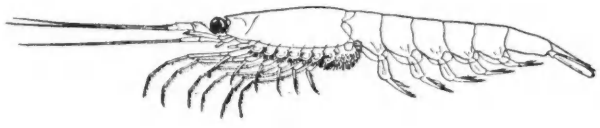
Other attempts to determine whether depletion is occurring to a dangerous extent are more beset with difficulty. A decline in the number or size of the individuals of any species taken in a given area, even when catching power remains constant, can be taken as conclusive evidence only when continued progressively over a term of years. A decline in catch has in certain years been followed, without any artificial rest from persecution, by a rise. In other words, apart from any effect of the operations of man, abundance fluctuates owing to natural causes. If, as seems probable, observations on the conditions prevailing over the whaling area repeated over a term of years can lead to the understanding of the causes of these fluctuations, the nature and extent of the fluctuations can be ascertained. It is for this reason that year by year the Committee's vessels are carrying out systematic surveys, over and beyond some of the chief southern whaling grounds, to study conditions, biological and hydrological, both in the waters in which whales congregate and also in the adjacent waters in which they are scarce or absent.

Unrestricted Whaling.

The report proceeds to discuss problems arising from unrestricted whaling. It has been said that the most successful whaling of 1927-28 was carried out by floating factories working, not in coves or harbours, but along the edge of the Antarctic ice. Probably South Shetlands whaling would in any case have enjoyed a good season. In South Georgia the season was poor, and whaling in that Dependency and in the South Shetlands not infrequently shows a complementary rise and fall. This success of whaling away from a shore base led immediately to an enormous expansion of pelagic whaling, an expansion which is moreover not yet spent, and which having taken up a large volume of invested money in Norway, shows signs of absorbing increasing amounts of capital from other countries. Pelagic whaling consists in the working up as well as the capture of the whale in the open sea. The modern pelagic whaler is a large floating factory equipped with a slipway in stern or bow by which the whale can be taken bodily on board for dismemberment and "trying down." As long as she works outside territorial limits she is subject to no regulation except those imposed by the Government of her own country. At present, while there is hope that certain steps may be taken to prohibit her from destroying cow whales with calves, it is difficult, if not impossible, for her to work up whale meal or guano, and there is reason to suppose that the extraction of oil from the carcase is less complete and therefore less economic than at a shore factory. There is, further, no means of restricting the number of pelagic whalers or of the catchers they employ. Pelagic whaling thus is not merely a less economic method, but it permits of indefinite extension of the grounds worked and unlimited increase in the intensity of whaling.

Another section of the report deals with observations

on the maturity and breeding of whales, both in the Dependencies and in South Africa. It is obvious that a very high percentage of captured immature individuals among a slow breeding stock is a dangerous feature in regard to the future. But it is difficult to apply the proportions found to the whole stock, even when these shall be based on adequate numbers, since there is reason to suppose that whales do not always move in herds composed of individuals of mixed sexes, sizes and ages. Thus in the South Georgia season 1925-26, while the majority of Blue whales taken were small, large specimens were caught early in the season, disappearing in November; in the following season, however, which was characterized by exceptional prevalence of ice near the island, these large whales appear to have remained. They were not abundant in the South Shetlands. It is at least probable, therefore, that the herds of large whales moved as a whole. The high percentage of immature specimens among the Blue whales must thus be considered with caution as an index to the condition of the main stock; but it does not help to justify unlimited destruction.



THE WHALES' FOOD.
Diagram reproduced from the report, showing *Euphausia superba*, the food of Blue and Fin whales in the Falkland Islands Dependencies. (Actual size.)

The same warning is sounded more emphatically by the conclusions reached as to the rate of reproduction. Study of the length of foetuses of Blue and Fin whales found in whales in successive months indicates a period of about a year from pairing to birth (which in both Blue and Fin whales occurs at rather over 6 metres, or about 20 feet). Consideration of this period, the proportion of whales pregnant and other relevant facts, suggests that the young are brought forth once in two years at most, a conclusion which has already been reached in regard to northern whales. As a rule but one calf is born, though twins occur occasionally, and yet more rarely higher numbers of foetuses are found. The rate of recuperation of stock thus appears to be slow. It may be added that the investigations have contributed materially to the knowledge of the breeding seasons of the Blue and Fin whale. Attempts which show some promise are being made to cast further light on the rate of recuperation of supply by determining the rate of growth after birth.

The distribution of whales and their migrations have been studied in various ways apart from the statistics of the whole catch. Whales seen from the research ships have been logged consistently, and the records obtained do nothing to support the hypothesis that they are abundant throughout the southern seas. Observations from two ships are naturally inconclusive, however, and the help of the whaling companies has been obtained in preparing charts of positions at which whales have been taken or seen by the whaling fleets.

The extensive examination of the food of the whales had shown, as stated in the 1927 report, that the Blue and Fin whales of this area were eating one species only, the shrimp-like *Euphausia superba*. In the observations at Saldanha Bay, although fish were found in one Fin whale, the food was found to consist almost entirely of Euphausians. These, however, were rarely present in large quantities; and it is to be remarked that in one season at least the Blue whales taken at South Georgia early in January were nearly empty of food and later were full. It would seem established, therefore, that over a great area of the Southern Ocean one species is taken by these whales, even at the cost of a scanty diet in their absence, accounting for its importance as a whaling ground.

The report discusses in conclusion the future activities of the "Discovery" committee. The great increase which will occur in the destruction of whales—sufficient to alarm experienced whalers, whose immediate interest is in an expanded industry—greatly increases the need for a speedy attainment of definitive results in the researches. The facts have to be faced that the industry may be irreparably damaged before the greatest diligence in research can furnish complete solutions of all the problems with which they deal, and that measures of a tentative and temporary character may have to be decided upon by the Governments interested in order to avoid a possible collapse. Two conclusions at least seem to emerge from the new increase of unlicensed whaling. The first is the need of increased research—possibly even of a greater scale of operations—to give results in time to be of value. The second is the desirability of enquiry in other parts of the Antarctic, which in co-operation with the "Discovery" work should form an adequate and co-ordinated whole.

Krakatau and the Thousand Islands.

By G. A. C. Herklots, B.Sc., Ph.D.

Reader in Biology, the University of Hong-Kong.

While attending the fourth Pacific Science Conference held this year in Java, the writer took part in two special expeditions to Krakatau and the Thousand Islands. The observations were mainly biological, but interest was heightened by the new activity of this world-famous volcano which occurred in recent months.

THE catastrophic eruption of 1883 directed the attention of scientists throughout the world to the Krakatau Islands, and this interest has been reawakened owing to the activity of a submarine volcano during the last three years. The group of islands includes Krakatau or Rakata, Lang Eiland, and Verlaten Eiland, and is situated in the Sunda Strait between the Greater Sundas, Sumatra and Java. It may be imagined, then, with what interest delegates from all over the world looked forward to the opportunity of visiting them which was afforded by the fourth Pacific Science Conference, meeting in Java under the auspices of the Netherlands and Netherlands East Indies Governments, and scientific associations. We left Tandjoeng Priok (the port of Batavia) on the afternoon of 12th May, the geologists embarking on the Government steamship *Wega* and the larger party of biologists on S.S. *Rumphius*, kindly placed at our disposal for this excursion by the K.P.M. line.

KRAKATAU.

The island photographed from aboard the *Rumphius*. The peak of Rakata, about 2,500 feet high, was seen enveloped in mist as the vessel approached.

The geological history of the islands can be briefly summarized. Originally there must, in all probability, have been a single volcano about 6,000 feet high, this being destroyed subsequently, leaving four remnants. Later an eccentric basaltic volcano was formed covering the remains of Rakata, the largest island, and this was followed in turn by submarine activity and the formation of an island with two volcanoes which joined up with Rakata. In 1883 the world-famous eruption took place which added considerably to the magnitude of the three larger islands by the addition of ejecta from the volcano. The eruption terminated with the destruction of the two volcanoes produced during the previous period of activity, and also with the destruction of half the basaltic cone of the peak of Rakata. Since 1883 there has been considerable abrasion by wave action, especially on the western coasts of the three islands, and a silting up of the low northern portion of Verlaten Island. Finally the submarine activity commencing towards the close of 1927, produced first a volcanic cone which appeared above the surface on 26th January, 1928, and which later disappeared, worn away by the waves; and secondly on 28th January, 1929, a new island of basaltic magma, the "Anak" of Krakatau, which has disappeared since our visit on 13th May.

The eruption of 1883 destroyed all the vegetable and animal life on the three islands, and therefore all forms of life which now inhabit them must have been borne there by wind, or tide, from the neighbouring islands in the Sunda Strait or from Java or Sumatra. The evidence for the complete destruction of life cannot be reviewed here, but it is very convincing. Dr. W. M. D. van Leeuwen, who has studied the Krakatau Islands for many years, says: "We have the choice between two opinions—the first, which is shared by all students who have visited Krakatau, that all life was destroyed and that all the present elements are derived from imported plants, spores, or seeds; the second, that part of it was latent, in the form of seeds or otherwise, under the layer of ashes and later grew up and formed new plants."

We approached the group of islands from the east just before sunrise, and whilst the S.S. *Wega* went in between Lang Eiland and Rakata, the writer's party in the *Rumphius* sailed round the south side of Rakata and were at the western side of this island when the sun rose. Here we anchored for breakfast. The peak of Rakata, 813 metres high, was crowned with heavy clouds, but these presently disappeared, leaving us no protection from the heat of the tropical sun. After breakfast the biologists completed the circuit of the island and were landed on the south-west shore. Viewed from the ship, the island is seen to be clothed entirely with vegetation from the coast to the summit of the peak, bare areas of rock being visible only on the precipitous and scarred face to the north. The vegetation is extremely interesting on account of the fact that nothing is indigenous, and the successions of plant communities and their struggle for survival have afforded much material for valuable study. In 1883, a few months after the eruption, Verbeek found not a single plant, and in the following year only a few shoots of grass remained. Treub in 1886 found 26 species; Penzig in 1897, 61 species; Ernst in 1906, 108 species; and Dr. van Leeuwen, between the years of 1908 and 1928, 276 species of which more than half were Dicotyledons.

As the boat approached the island the interest of the botanists on board increased, and soon certain plants in the outermost communities could be recognized from the ship. The shore is seen to be composed of a grey sand formed from volcanic ash and pumice tuff, above the wave line is a beach formed entirely of rounded masses of whitish-grey pumice. The flora of the beach presents no features of unusual interest to the botanist familiar with the islands of the eastern tropics, and the plants found can mostly be found in the islands of the Dutch East Indies, the Malay Archipelago and south China. Certain features, however, strike the eye of the visitor, for example, the abundance of the creepers, *Ipomoea* and *Vitis* species, which bind together loosely the masses of pumice. In places the beach is strewn with logs and tree trunks, many of which may have drifted thither from the islands of Java and Sumatra, and this indicates how many of the forms of plants and animal life have reached the islands. I picked up several seeds on the beach of species of palm, etc., but saw very few shells.

THE PEAK OF RAKATA.
The crowning feature of Krakatau is here observed from the beach, on which scattered drift wood. Casuarina trees are growing on the left.

VERLATEN ISLAND.
This shows the creepers binding together the loose pumice stone on the beach, and in the right foreground can be seen specimens of *Hibiscus tilliaceous*.

Immediately behind the beach is the Barringtonia community which is permanent but limited in most places to a narrow strip. Many of the plants in this community could be recognized from the ship, including the widely distributed *Hibiscus tilliaceous* with its beautiful yellow and orange flowers. In this community can be seen large specimens of *Cerbera Manghas L.*, and these are of particular interest, as being the only species representative of the mangrove swamp flora which has managed to get a footing on the island. I myself picked up two or three seedlings of *Rhizophora mucronata* on the beach, indicating that if the environment were suitable mangrove species would soon make their entry.

The Casuarina community is of interest and is worthy of mention here. Casuarinas grow best when

ANCIENT MANGROVE TREE.

The aerial roots typical of this type of tree (*Rhizophora muscronata*) should be noticed. The photograph was taken in a shallow lagoon on Hoorn Island.

alone in open sandy spaces, especially where these are extending, *e.g.*, the north point of Verlaten Island. Here on Krakatau the Casuarinas are gradually dying off, being killed out by plants spreading from the Barringtonia community assisted by climbing plants. It is a novel sight to see a 100-foot high Casuarina hidden completely by masses of creeper. The Macaranga community is to be found on the sides of the ravines, and includes a number of species of figs and ferns.

The mixed forest presented many features of interest to the visitors. It must be remembered that in this dense rain forest there are very few animals. A couple of species of lizard are very common, there are also two species of snakes and a few rats, but practically no other living creature disturbs the floor of the forest. The leaves which fall from the trees rot where they lie—I picked up several perfect leaf skeletons—and form a layer of pure vegetable mould on top of the fertile soil of pumice and volcanic ash. In this humid environment fungi flourish and brilliantly coloured Polypores and Stereums catch and hold the eye of the visitor. Coming from China, I found that the abundance of the papaya trees and Lantana camara shrubs was amazing. In China Lantana grows in thickets but always in the open near a native village or path, and the papaya is rarely to be found away from cultivated ground. I noticed but few species of figs, but certain species were very common, and I recognized old friends in *Ficus fulva* and *F. hispida*. There was insufficient time to visit the plant communities on the higher levels.

We returned to the *Rumphius*, sailed to the north-east corner of Verlaten Island and anchored, the geologists from the *Wega* joining us for lunch. In the afternoon a large number of us landed on Verlaten Island and explored the salt marsh and also a part of the wooded area, before sailing back in the evening to Tandjoeng Priok.

On 15th May, the day before the Science Conference was officially opened by the Governor-General of the Netherlands Indies, a second excursion on the *Wega* was arranged to certain of the coral islands in the Bay of Batavia. These form the southern part of the Archipelago of the Thousand Islands, which is of particular interest to scientists engaged in coral reef investigations, as it contains islands in every stage of construction, from submerged reefs and barren sand banks, to islands thickly wooded and bounded by lagoons large or small. On the way to and from Krakatau we had observed these islands, and as we

SPECIMENS OF CORAL.

The author is here holding some corals. Festooned over a branch of *Montipora* is a black Holothurian of the type described in the text.

steamed north we passed many more. We were to visit the two islands of Hoorn and Onrust, both of these mature and possessing features which single them out from the myriad of other islands.

The plan upon which the different islands have been envolved is more or less similar. Water-logged pumice stone, shells, etc., embedded in the mud of the bay serve as anchorages for the young corals which grow up and form submerged reefs. As the growth reaches the surface certain species die, become dislodged and are piled up. These fragments are cemented together to a greater or lesser extent by the calcium carbonate, held in solution in the sea water, which is precipitated when the water evaporates under the influence of the tropical sun during periods of low tide. Dr. J. H. F. Verwey believes that in the case of the Batavia bay coral islands the conglomerate has been formed in a somewhat different manner. He suggests that the conglomerate is formed by fresh water, derived from monsoon showers, flowing out laterally from the centre of the island towards the shore, where it evaporates at the beach-line leaving the lime, which was dissolved from the centre of the island, to cement together the loose fragments.

LANDING AT VERLATEN ISLAND.
Members of the Pacific Conference included biologists and geologists of many nationalities.

All the islets show a similar distribution of the finer coral sand and the coarser coral shingle, and this has been correlated with the strength and frequency of the prevailing winds. The greatest wind influence is from the north and north-east, and all the islets reflect this, the shingle beaches being to the north-east and the island of finer sand lying to the south-west. The wave action results in the formation of a high shingle beach to the north and north-east, and behind this and protected by it lie the shallow lagoons. The waves rush over the ridge into the lagoon, and then the water flows right and left returning to the sea. The depth of the lagoon keeps more or less constant because, if the coral growth in the lagoon becomes so luxuriant as to check the flow of the water escaping to the sea, then the wave action becomes consequently more violent and more corals are broken and destroyed by its influence. Gradually the lagoon is filled in by fragments which fall down from the shingle wall and in an old island there is only a small lagoon, or the lagoon is completely filled in and a large and high shingle wall abuts directly on to the sandy island. Some of these islands are definitely moving south or south-west, and this is shown by the fact that mangrove trees are more frequently found on the north-east side and then are often seen to be growing in the lagoon itself.

Hoorn is a mature island with a relatively small lagoon extending along the northern side. About forty-five years ago some monkeys were released on the island; during certain experiments they had been inoculated with an unpleasant disease, and it was thought that these forty or so individuals would soon die. This has not been the case, however, and now there must be at least one hundred of the species on the island; monkeys eat anything, and as a result the fauna of the island has been affected by their activities. There are fewer birds than on some of the neighbouring islands, while certain crabs and many of the mollusca are much rarer than they ought to be.

The party of biologists which landed on the south side of Hoorn contained many nationalities, German and Japanese, Dutch and French, English, Americans, and Chinese. No fewer than two hundred and fifty delegates were attending the conference, which attracted visitors from the principal countries bordering the Pacific Ocean. As already stated, the majority were the guests of the Government during their stay in Java.

We presented a curious appearance, for we were dressed in the strangest of garbs. I observed a well-known American algologist in white "plus fours" carrying an enormous umbrella to protect him from the rays of the sun. The most popular garb consisted of a bathing costume, heavy shoes and stockings, a shirt worn over the bathing costume, a topee and a towel wrapped round the knees! The sun

was very powerful, and many of the men present were not in the habit of exposing their skins to the tropical sun, hence these very necessary precautions.

Three plans were adopted by the various members of the party. Some, carrying in their hands glass-bottomed buckets with two side handles, waded out into the sea at the south-east corner of the island and, when up to their shoulders in the water, immersed the glass window of the bucket on the sea and peered through at the marvellous panorama visible below. The water was as clear as crystal, and those who chose this form of entertainment will remember it as long as they live. The floor of the ocean was carpeted with corals, pink, red, yellow and brown predominating. Above this carpet moved an endless procession of living creatures. Swarms of multi-coloured and fantastically shaped fish moved in stately procession, or chased each other in and out of the maze of corals—there an enormous Nereis meanders between the stately columns of a giant yellow sponge, here a school of Parrotbills are standing perpendicularly on their heads in the water feeding off the algae which cover the corals. And a black Holothurian worms its way in amongst the forest of corals. A handsome Squill shoots across the field of vision and momentarily causes one to lose sight of a hermit crab lazily climbing a tree of coral.

Lagoon Fauna.

Others visited the lagoon and examined its complex fauna. Near an ancient mangrove tree I observed two or three very long Holothurians, which I believe were Synaptas; a little further off were many of the shorter and stouter black species of *Bèche de mer* or "Trepang," which is so much prized by the Chinese as a table delicacy. The lagoon of this island can be divided into three sections: (1) An eastern section almost entirely cut off from the sea; (2) a central section which is connected to the sea through shallow breaches in the shingle wall; and (3) a western section always in direct communication with the sea. As one walks through the lagoon from east to west the fauna is seen to become richer and more varied. This is, of course, due to the fact that the eastern end is exposed to more extreme conditions of temperature, oxygen content, and of polution with organic matter, than the western end, which approximates more to the open sea conditions. In the lagoon were coal-black sponges, blue starfishes (*Linckia miliaris*), long spined black sea-urchins, fragile dark green crinoids, green Nereids, and beautiful Gasteropods.

One of the most interesting features observed was the variety of organisms living commensal existences. A pale mauve anemone forms the palace and gardens, as it were, for a species of damsel blue fish with golden bars. A bright emerald green anemone houses a swarm of little fishes no less vividly painted than itself. But these are not the only common example that can be quoted. Over there is a swarm of little fishes swimming about above the forest of coral—suddenly the fish are disturbed and they vanish into the corals themselves. Here is a little goby which lives in a hole in the coral and employs a small lobster as housemaid to brush out its home and keep it clean. There is another fish which is so like an encrusted coral in appearance that it is not easy to spot the creature till it moves and betrays its existence.

The Coral Reef.

Many of us next visited the reef itself and waded in the open sea beyond. It is no joke wading up to the waist and ploughing through sharp and multi-branched corals which frequently reach to the knees. I found that long trousers, with the ends tucked into thick socks, were most suitable for this exercise. In these reefs and in the open sea the Anthozoan corals, particularly the Madreporia, predominate, and masses of stag's-horn-like species of Montipora and flat pectinated tables of red species of Acropora hold the eye—and feet also, if one is not very careful. There are, however, representatives of the Alcyonaria three feet in diameter, some of which sting rather painfully. Here, as in the open sea to the south of the island, the number and variety of brilliantly coloured fish is amazing. A ripple or a miniature fountain on the surface of the placid sea betrays the presence of some gigantic clam or other bivalve.

Our visit to the island of Onrust, which followed a soup and sandwich meal on the *Wega*, was of short duration. On this island is a quarantine station, but of much more interest was the small aquarium which has been erected there for the study of the reef fauna. Here we saw many examples of commensal life between anemone and fishes, and also specimens of the species we had seen earlier in the lagoon. We returned to Batavia thoroughly exhausted, and with severely sunburnt necks and legs, but with the memories of visions that some of us had seen for the first time—visions that we had read about and visualized so often in our school and university days.

In conclusion, I must acknowledge indebtedness to Professor O. de Vries, the President of Conference, for permission to make use of the Conference handbooks in the preparation of this article. I am also obliged for the photograph of the Peak of Rakata to Mr. R. E. Holttum, director of the Singapore Botanic Gardens.

The River Valley Men of East Anglia.

By J. Reid Moir.

Excavations in the Gipping Valley near Ipswich have brought to light some further data regarding early man in East Anglia, to the study of whose history the author has long devoted his spade.

In the upper reaches of the Thames Valley, and in most other valleys in southern and eastern England, there is, on either side of the existing river, a wide and relatively flat area bearing, usually, a luxuriant and valuable vegetation. This excellent pasture remains green and fresh even in the driest season, and the reason for this is that water is present only a few feet below the surface. The bottoms of these valleys are, in fact, water-logged, and while from the grazier's standpoint this is more than welcome, it is otherwise with the archaeologist. For ordinary methods of digging fail in such saturated deposits, and it is only when—for one reason or another—these are removed by some other means, that it is possible to ascertain what remains of early man they contain.

It has thus come about that next to nothing has been known of the archaeological contents of the deeply-buried deposits of our river-valleys, and this lack of knowledge has, without doubt, constituted a serious obstacle to a proper understanding of the history of ancient humanity in England. This being the case, I decided, some little time ago, to attempt to throw some light upon this obscure question, and by means of grants from the Royal Society and the Percy Sladen Trust, I have been enabled to carry out a thoroughgoing, and, I hope, valuable research upon the matter.

Now the deeply buried deposits which have been under examination occupy the very bottom of the Gipping Valley in Suffolk, where my work has been undertaken, and the position of these beds is clearly shown in the diagrammatic cross-section illustrated in Fig. 1. The deposits in question are known to geologists as the Flood Plain Terrace, and they represent the result of the last work done by the river before it succeeded in cutting its channel down to sea-level, and lapsed into its present inactivity. Thus the beds forming the Flood Plain Terrace are of late geological age, and would be expected to contain the remains of the races of people living towards the close of the greatly extended period when the use of metals was unknown, and implements and weapons made of wood, bone and stone were in daily use.

This period has been divided up by archaeologists into three main stages which succeeded each other in the following order, *viz.*, Eolithic, Palaeolithic, and Neolithic, and there are good grounds for believing that the most ancient, Eolithic, artifacts are to be referred to an epoch separated from the present by at least 500,000 years. The three main divisions of the Stone Age have been further sub-divided

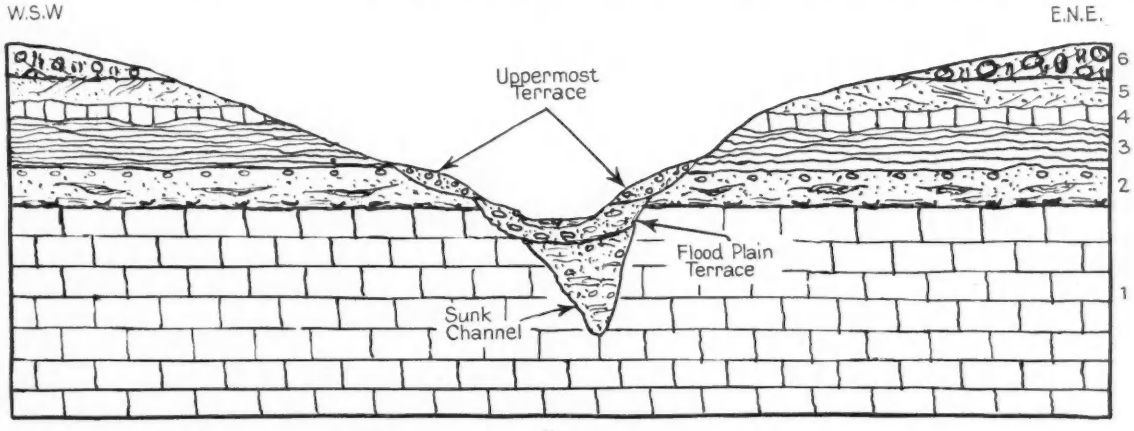


Fig. 1.
DIAGRAMMATIC CROSS SECTION OF THE RIVER GIPPING.

The layers indicated by the numbers on the right are (1) Upper Chalk, (2) and (3) Eocene Beds, (4) Red Crag, (5) Glacial sand and gravel, (6) Upper chalky boulder clay (Glacial). The position of the Flood Plain terrace described is indicated by arrow. (Not drawn to scale.)

according to the specific types of implements used in the different periods which go to make up these divisions and have been given various names, which, while well known and understood by the expert, are often a source of perplexity to the non-archaeological person. It is necessary, nevertheless, to give names to these "industries" as they are called, and as this article deals mainly with those belonging to the latter part of the Palaeolithic division I propose to enumerate them in the order in which they occurred in the past. The most ancient is the Aurignacian; the less old is the Solutrean, while the youngest is the Magdalenian. These names are derived from certain places in France where the particular industries were first found, and it is possible that the Aurignacian was flourishing about 30,000 years ago.

After the close of Palaeolithic times—the last phase of the Stone Age—the Neolithic, was inaugurated, and this period is also represented in the deposits forming the floor of the Gipping Valley. The Gipping is a very ancient river, and was in existence many hundreds of thousands of years in the past. It has cut its way down through the beds forming the plateau of Suffolk (Fig. 1), and at one time was a broad and majestic stream filling its valley from side to side; but to-day it is an insignificant and sluggish affair kept in being by lock gates. Towards the close of its work of eroding its channel, the valley was inhabited by a race of people who had, no doubt, come up into East Anglia in pursuit of big game which was then present in quantity in this part of the country. These Solutrean hunters, as they are called, made beautiful leaf-shaped blades of flint which have been found in many caves and other places upon the continent of Europe. The ancient land surface upon which they lived in the Gipping Valley is clearly shown in the section of deposits forming the Flood Plain Terrace of this river (Fig. 2), and it will be seen that, since these people existed, a thick bed of gravel, surmounted by peat, has been laid down in the valley.

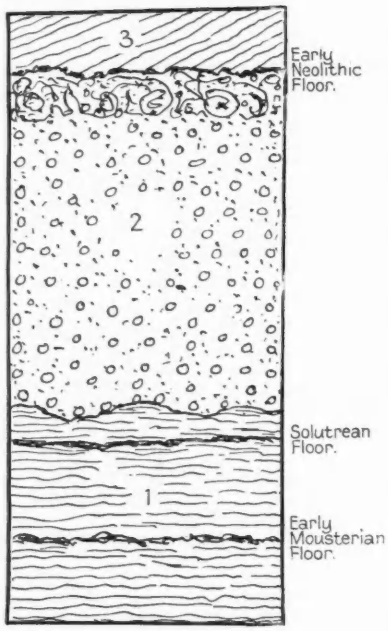


FIG. 2.
SECTION OF DEPOSITS
forming the Flood Plain Terrace in the Gipping Valley. (1) Grayish loam (depth unknown) with early Mousterian and Solutrean floors, (2) Stratified gravel contorted at surface to eighteen feet, (3) Peat with early Neolithic floor at base to four feet.

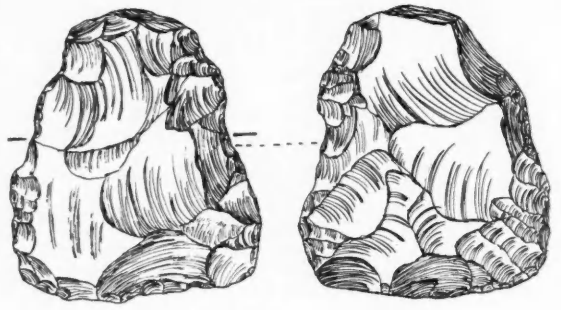


FIG. 3.
EARLY MOUSTERIAN HAND AXE.
Two views (actual size) of a hand axe of the type discovered in the loam below the Flood Plain Gravel near Ipswich.

Below the land surface upon which Solutrean man lived has been discovered another and much more ancient dwelling place of man. This latter level is shown in Fig. 2, and is referable to a phase of the earlier Palaeolithic epoch. The implements of this period are known as the Combe Capelle type (Fig. 3), because it was at Combe Capelle, in France, that they were first discovered. With these specimens in the Gipping Valley have been found abundant remains of the mammoth and reindeer, thus showing that East Anglia was experiencing a cold climate in those days. If reference is now again made to Fig. 2 it will be seen that, towards the surface of the gravel overlying the ancient occupation-levels in the loam, a considerable amount of twisting and contortion is observable. The gravel was laid down by water, and was originally stratified in definite layers, and it is evident that the contortions in its upper portion have been produced since its deposition. There is little doubt that ice was the cause of this disturbance, and that we have evidence here of the last effort of the Great Ice Age before it finally gave way to the mild and temperate climate we now enjoy. Above the contorted gravel (Fig. 2) is peat containing the remains of plants comparable with those existing to-day and at the bottom of this deposit is found definite evidence that, for a prolonged period, the surface of the gravel was a land surface inhabited by Neolithic man.

Among the many bones being recovered from the

Flood Plain Terrace deposits of the Gipping Valley are two examples, parts of a femur and a tibia (thigh and shin bone) of man. Unfortunately, these relics are very fragmentary, but their condition is the same as that exhibited by the bones of the mammoth and other extinct animals, from the Flood Plain Terrace, and represent, probably, parts of the skeleton of one of the Solutrean hunters. The work now being undertaken in the Gipping Valley is not only bringing to light great quantities of the flint implements of the ancient inhabitants of East Anglia, but is throwing light upon many obscure problems in the prehistoric archaeology of England. The examination which has been made of the Flood Plain Terrace of the Gipping Valley was made possible by the work carried out some years ago at the Electric Power Station at Ipswich, where a caisson was used, and by the activities of an enterprising firm of gravel merchants who are using a powerful suction pump to raise the ballast. Without these commercial undertakings the knowledge now possessed of the River Valley men of East Anglia would not have been acquired.

War on Locusts.

ALTHOUGH the locust was probably the first insect definitely to be recognized as a noxious pest, far less is known about its natural history than about many less serious insect pests, the economic importance of which have only been ascertained in relatively recent times. There can be little doubt that this comparative ignorance is mainly due to the periodic nature of the swarming of locusts. When such swarms occur and cause great material damage, efforts have been made from time immemorial to combat them, but as the swarms decrease in size, the administrative measures devised during each emergency are gradually relaxed. As a rule, after a period of years, the number of locusts found becomes negligible and the immediate losses disappear. An entirely false sense of security is engendered and usually nothing is done until the next period of swarming becomes round. The vicious circle is then complete, and heavy expenditure is again incurred on hastily devised palliatives.

With this state of affairs in mind, the sub-committee of the Civil Research Committee appointed to investigate the locust is to lay before Parliament a scheme of Empire research which should give valuable results. As illustrating the large expenditure incurred in the absence of a central organization, it is reported that in Kenya alone £200,000 was recently allocated for fighting this insect. As a preliminary step the Committee suggests the collection of information from all possible sources about the Desert Locust.

Book Reviews.

Industrial Psychology. Edited by C. S. MYERS, M.D., Sc.D., F.R.S. (Thornton Butterworth. 2*s.* 6*d.*).

Joy in Work. By HENRI DE MAN. (Allen & Unwin. 8*s.* 6*d.*).

No recent addition to the Home University Library should have a warmer welcome than the first volume under review. The name of the editor is sufficient guarantee of its importance and interest, since as Director of the National Institute of Industrial Psychology, Dr. Myers has been able to command contributions from the staff under his direction, who are in personal touch with the detailed problems which each section of the book describes. One exception is made in the case of a chapter on "The Human Factor in Industrial Relations," contributed by Dr. J. Drever. The book is thus the fruit of first-hand experience, and, in addition to the work of the Institute, the researches of the Industrial Fatigue Research Board have been drawn upon.

It is not possible here to discuss the chapters in detail—some of their titles are Work and Environment, Unproductive Working Time, The Measurement of Intelligence and Economic Aspects—but as indicating the broad scope of the subject we cannot do better than quote Dr. Myers' introduction. "Industrial Psychology," he says, "is the most recent application of the National Sciences. Psychology, the science of the mind, has emancipated itself completely from the leading-strings of Philosophy by which it was first nurtured. Like Physiology, it has now become established as a branch of Biology, dealing with the functions of the living mind just as the former deals with the functions of the living body." That the most recent example of applied psychology—industrial psychology—is concerned with the human factor throughout industry its name at once indicates, but it is not so widely appreciated that "industry" is here construed to embrace *all* occupations in *all* branches of work and among every grade. The present book does much to bear out this important generalization, at the same time giving full data to support conclusions, together with suggestions for their practical application.

The second volume under notice is written by a German author, and ably translated by Eden and Cedar Paul, who have already made a reputation for their versions of several of Emil Ludwig's works. Herr de Man collected the reports of seventy-eight persons with whom he had contact at the Frankfort Labour College, mainly industrial workers, and has deduced the conditions which promoted pleasure or intensified distaste for their various occupations. He divides the book into two parts, the first discussing the impulse to joy in work, and the second the hindrances to and inhibitions of this end, further classifying the latter into technical and social factors. So far as the book provides data of particular cases, it is a valuable contribution to industrial psychology, but whether the author's conclusions have the same worth is open to question. The general problem of "Man versus Machine," familiar even before the writings of Samuel Butler, leads to various theories about the future, on the basis of the so-called "ethical socialism" which de Man has developed before in other writings.

The answer, however, to what is likely to remain a problem so long as machinery exists, is ably provided by Dr. C. S. Myers in a couple of sentences which should provide inspiration for every student of the subject. There is surely no reason why our attitude to work and sport should continue to differ so

widely as it does at the present day. "Why should we not entertain the social and economic ideal that, as output increases per worker, he may be enabled to earn more, not only in wages, but also in leisure? Why, again, should not the ideal result of increasing machinery ultimately be not to increase monotony but to reduce it."

An Introduction to the Study of Bird Behaviour. By H. Eliot Howard. (Cambridge University Press. 42*s*.).

By reaching me again at this encampment in the tropical rainforest, after I had already formed a high opinion of it before leaving home, Mr. Howard's book courts a most searching scrutiny. What value, I may well ask, has this generalized picture composed for the most part in a corner of Worcestershire, when we get right away from the conditions under which it was written? Are the conclusions which Mr. Howard has drawn from the behaviour of such strange exotic species as the reed-bunting and the whitethroat, in a rather obscure northern island, at all applicable in such fields as this, where toucans, humming-birds, parrots and trogons are the everyday representatives of bird life?

This excellent strategic position, however, is of no use to me at all; I only know that the beautiful simplicity of those bird-tenanted northern hedgerows is not duplicated here in the largest forest in the world. There are territorial species certainly; every day I meet *Hypocnemis cantator* in the same clearings, or hear his distant voice which is like music to me because he is typical of the simple polity in which the white-throat and the reedbunting live. But here he is not typical; he is prominent through being an exception to the unrecognizable rule. In Greenland last summer I saw the virtual breakdown of territory through a superfluity of food during the breeding season; here in Guiana we are at the opposite extreme, and with the disappearance of dominance as a conspicuous factor in animal communities we have to admit a severe restriction of the extreme territorial activity which (as observers in temperate regions have been slow to realize) is to some extent linked up with it.

It is still open to question whether the normal territorial life of small birds which Mr. Howard has unravelled in England can be treated as normal for more than a considerable fraction of the earth's surface. Yet he is not to be blamed for the smallness of his foundations; if he had aimed at more he would certainly have achieved less. Attempts to arrive at valid generalization for which the material does not yet exist are frequent; Mr. Howard is the only observer who has yet devoted a lifetime to filling the breach, and if he has not provided any final and complete solution of the problems whose existence he was one of the first to grasp, he has at any rate supplied a definite standard of comparison which we know is sound as far as it goes. For that, little as it appears, observers in all parts of the world must be grateful for a long time to come; the recognition of this aspect has given ornithology for the first time a place amongst the sciences, making it a study instead of a pursuit. This book, which sums up a great effort of constructive observation, will undoubtedly remain amongst its classics.

E. M. Nicholson.

Oxford University British Guiana Expedition,
River Essequibo, B.G. 14th September, 1929.

(Comment on this review and the circumstances of its writing are made in the Editorial Notes on page 354).

Paleontology. By Edward Wilber Berry. (McGraw-Hill. 17*s*. 6*d*. net.).

The author of this volume is Professor of Paleontology in the John Hopkins University, and has produced a very readable elementary textbook for the use of the student young in the study of the subject. He tells us in the Preface that "most elementary texts discuss fossils in their often fragmentary condition as traces of long-dead organisms dug out of the rocks and chiefly useful as indicators of geological horizons." He, however, lays emphasis "on two aspects of the subject . . . resemblances rather than differences . . . and . . . adaptations of organisms to their environment. Without deviating from the facts, the purpose is to interest rather than repel the beginner." A distinctive feature of the work is the large space devoted to a description of the vertebrates, which are not so important to the elementary student in this country as on the American continent, but the importance of which, as data is accumulated, is becoming increasingly recognized. The illustrations are mostly diagrammatic, which certainly renders the task of the reader easier, but at the same time the specimens of a good museum are essential for a correct understanding of the evolutionary treatment.

It is unfortunate from a consideration of modern work that such a small space is devoted to the coelenterata, as both the graptolites and corals, besides being two of the most important groups used for zonal purposes over wide areas, are two of the best examples of trends in fossils that it is possible to demonstrate. A very useful feature of the book is the long glossary of terms, which is a great help to the reader.

At Home Among the Atoms. By James Kendall, M.A., D.Sc., F.R.S. (Bell & Sons. 7*s*. 6*d*.).

This book, by a leading authority on the science of chemistry, is not intended for the scientific expert but for intelligent men and women who wish to "keep up with recent advances in . . . science."

To make a scientific work entertaining to the general body of the intelligent public is a difficult matter. Fortunately there are a few modern scientists, and they of the highest eminence, who possess this gift to a superlative degree. A few of these whose writings are as familiar to the public as their daily newspaper, are Sir William Bragg, Professor Eddington and Professor E. N. da C. Andrade, not to mention the author of this book. At the same time it is impossible to make legitimate science entertaining to the layman by the infusion of imagery and humour, unless the will to be entertained is present. If this condition is satisfied then the necessary entertainment is provided by a recital and explanation of scientific phenomena, stripped as far as it is possible of all technical phrases and mathematical expression—and herein lies the art. Analogy is useful, but its value very probably will show itself to be in strict ratio to its scarcity.

It must be confessed that after reading Professor Kendall's book we received a slight impression that reminded us of the story of the stumbling child who, towards the end of a strenuous and wet Bank Holiday, was slapped by its tired mother with the remark, "Come on, carn't yer—I brought you out to enjoy yourself and you've bloomin' well got to."

There are certain aspects of chemistry which always present difficulty to the tyro. The combining ability of atoms is one of these. It is called "Valency" and in dealing with this difficult subject Professor Kendall is at his best. His explanations and

descriptions of the activities of the various elements are extremely graphic and should prove of great value to the elementary student of chemistry. Indeed, the examples and explanations throughout this book are so palatable that the reader is stimulated to envy Professor Kendall's regular students. Atomic Weights and Isotopes are dealt with in a most interesting manner, and although these matters are difficult and normally without popular interest, yet in the hands of the author they become intriguing characteristics which confer almost a dramatic tone on the subject.

The chapters concerned with physics are not so satisfying; but after all it is not possible to deal very fully with modern atomic theories, including the latest views on wave mechanics, in thirty-two pages.

The historical references and quotations are interesting and apt; but we are sorry that Professor Kendall thought fit to attribute the sharp practice of Lavoisier to his legal ancestry. It is a pity that in his desire for "alleged witticisms" the author should have been led so to malign a most honourable and learned profession.

There appears to be a misprint on page 105—the wave lengths of X-rays surely approximate more to one ten-thousandth part of those of ordinary light rather than to one thousandth as it is stated. The book is exceedingly well produced and the illustrations, of which there are some sixteen, are excellent.

V. E. PULLIN.

The Voyage of the "Discovery." By CAPTAIN SCOTT. Popular Edition, with a preface by DR. NANSEN. (John Murray. 7*s.* 6*d.*).

The Polar Regions in the Twentieth Century. By MAJOR-GENERAL A. W. GREELY. (Harrap & Co. 12*s.* 6*d.*).

Just at the time when the "Discovery" is again sailing for the Antarctic, under the command of Sir Douglas Mawson, the appearance of Captain Scott's book in popular form is a happy coincidence. Packed with photographs and maps, and comprising over seven hundred pages of close print, this surely creates a record value in cheap editions. Dr. Nansen contributes a preface which forms an eloquent tribute to a Britisher who must always remain the hero of Polar explorers. Though reference is made to the sad fate of the later expedition, from which Captain Scott never returned—the story of which is issued as a companion volume—the fact that the author here describes a successful voyage makes reading the more stimulating, being without the element of impending tragedy inseparable from the other story. In addition to the general narrative—itself a revelation in Polar technique—Captain Scott included chapters on such subjects as Sledge Travelling, which give the book permanent value for reference to problems of exploration.

Since the first voyage of the "Discovery" at the beginning of this century, there have been many expeditions alike to the Antarctic and the Arctic. These form the basis of the second book listed above, written by a retired officer of the U.S. army. It was in 1881 that the U.S. Army Corps Arctic Expedition set out under the author's command, and succeeded in covering a record distance in the Far North, as he described in a volume published at the time. General Greely has now set down the latest data about the regions which have excited his interest during half-a-century, though, as the title indicates, his new book is concerned mainly with discoveries of the past thirty years. During this time Peary, Amundsen, Scott and Shackleton, not to mention Nansen, Byrd, and Sir Hubert Wilkins, have all contributed to our knowledge of the Polar sciences. The book discusses these discoveries both from a geographical standpoint and also as regards their industrial significance, while even the recent experiences in Arctic aviation find their place in its pages.

General Greely has received the assistance of Dr. Rudmose Brown, of the University of Sheffield, in preparing the English edition for press, which is therefore free from those slight differences of idiom and other details which are often troublesome to readers of books printed in America and imported to this country. The publishers are to be congratulated on their production, which contains admirable photographs; but it is to be hoped that the second edition will contain a map of the Antarctic as well as of the Arctic regions.

London: Its Origin and Early Development. By WILLIAM PAGE, F.S.A. (Constable. 7*s.* 6*d.*).

Here, you would say on glancing at the title, must surely be some portentious volume, heavy with those mysterious words Staller, Soke, and Reeve, formidably complete and able, yet for that very reason all the more difficult for the ordinary reader to get through? Actually, 273 pages of clear print comprise the text of this book by Mr. Page, who is General Editor of the "Victoria History of the Counties of England," and in them we have chapters on Roman London, Saxon London, Norman London, the Sokes (for, of course, we cannot avoid them altogether), the Churches and Schools, the Wards, Early Government, Some Governing Families of England, the Growth of London. Obviously, the author must either have attempted too much, or have scamped his job? That neither of these charges are in any serious measure true is the sincerest tribute to this reissued work. Mr. Page succeeds in conveying so much in so little because he has the gift of conveying it in the simplest possible form. The ease of his narrative makes us forget the research which lies behind, or realize that anyone less master of his subject could only impart the same information in twice as many words.

And a fascinating story he has to tell. Those of us who have forgotten our early history, and are apt to consider that London, however small its origin, must have always reigned supreme, are reminded at the outset that St. Albans and Colchester have both the prior claim. The history of London, in fact, is the history of London Bridge. Here, from Lambeth to Westminster, from Southwark to the opposite shore was the lowest safe crossing of the Thames; and here, therefore, was the easiest access for invasion; the handiest meeting place for trade. "The place of nodality of the province, the knot of the cord, the strands, of which stretched into every part of the country," it quickly claimed predominance from this latter fact alone. On the withdrawal of the Roman legions in 410 and until the arrival of Augustine, London shared in the general obscurity which surrounded the rest of Britain, but from then onwards its wealth and its importance as the centre of the Kingdom grew. Under the Saxons, it became the obvious place for the holding of the *Gemotes*; under the Normans, the Sokes were formed. In this chapter Mr. Page is at his best. He shows us, as clearly as anyone could, how—and for what reason—the City boundaries were so rapidly enlarged; why, in them, the King—compared to the Barons—held so little sway; and also how the modern problem of the City Churches first began.

With regard to the Early Government of London the author traces the history of the office of Mayor from its inception at the end of the 12th century. He shows how, from election among the Barons themselves, that position came to be filled by a leading Alderman as now. Finally, in "The Growth of London" we watch the Metropolis which we know to-day emerging from a fishing village at the mouth of the Walbrook till by the 13th century it had assumed the proportions of a modern country town.

Further than that, unfortunately, Mr. Page's story does not go. But it should. Is it too much to hope that a sequel is in rapid preparation—"London—Its History and Development from the Plantagenets to the Present-Day"? To some of us such a volume would appear more interesting still.

Block Models illustrating Geological Structures. Second Series. By FRANK SMITHSON, Ph.D., F.G.S. (Thomas Murby. 1*s.* 6*d.*).

Continuing a set of models issued in the spring of 1929, the present series illustrates the structures exhibited by igneous intrusions and certain other phenomena not included in the first series. But so that all the models may be studied together, the same system of shading and numbering the beds is used throughout. The author indicates in a prefatory note how the finished models can be coloured, a suggestion of excellent value, since even more than in making the structures themselves, this further operation should impress their geological significance on the student's mind. For the convenience of those who require the finished models, sets are available at prices up to 18s. 6d., the latter being asked for models mounted on cardboard and coloured by hand. If this price is perhaps a little high, it is amply compensated for by the cheapness of the patterns under review, which are likely to have a wide circulation among geological classes.

The Charm of Surrey. By GORDON HOME (A. & C. Black. 7*s.* 6*d.*).

At a time like the present when, fortunately, several national movements are on foot to preserve the English countryside, too many books of the type under review cannot be published. Usually it is only when some celebrity draws attention in the newspapers to a particular place threatened with destruction that public opinion is roused, as in the case of Friday Street, saved for the nation in October by public subscription. It is, however, equally necessary to guard the beauty of our villages as a whole, and too often sites of public interest are built over or lost for lack of local appreciation of their history.

In view of the scenery for which Surrey is renowned, the title of Major Home's book will certainly satisfy those who live within its borders. But from a broader standpoint, another choice would perhaps have done more justice to the close research which the author has recorded in its pages. Not only are there many of the charming sketches for which Major Home has already made a reputation, especially from his volumes on "Roman London" and kindred archaeological subjects, but the book is also notable for several new matters of local history which it brings to light. In compiling his notes the author adopted the highly satisfactory method of staying in the local inns, no matter how humble their fare. The help of the landlord was often obtained in opening the doors of buildings in the ordinary way closed to the sightseer, while at other times the recollections of village "ancients" were doubtless of value. The result is an outstanding contribution to the study of the English countryside.

The Year's Photography, 1929. (Royal Photographic Society, London. 2*s.* 6*d.*).

This volume of photographs, selected from the several hundreds which constitute the annual exhibition of the Royal Photographic Society, brings home more clearly than any words can the remarkable progress which is every year made in this important branch of science. The world has become so greatly dependent on the photograph in every phase of modern civilization, that it takes too much for granted the labours of those who, by patient work and discovery, are always improving the photographer's art.

Several articles describing sections of the exhibition form an epilogue to this volume, and none is more interesting than a contribution from Mr. Oliver Pike. "The Popularity of Natural History Photography" is his subject, in the course of which reference is made to his own observations printed in *Discovery* for August. Speaking of a fine print of Oyster Catchers (shown by A. H. Willford), in which the female is relieving the male at the nest, Mr. Pike wonders if this male bird was as pleased to get away from the tedious task of sitting as some of the male birds he had watched? "While photographing the Black-necked Grebes at their nest I found that each sat for a spell of three hours. Each time that the male settled down he looked absolutely bored! I have never seen any bird show it so much."

In another paragraph Mr. Pike refers to a picture of a Whitethroat which brings back memories of the War. For with its photographer, Mr. L. J. Langford, he found a nest of this bird in France with the noise of war all around. "As we stood looking at the eggs, the owner fluttered in front of us, and we followed, to see her go through the clever performance of attracting us from the nest; feigning a broken wing, she led us for nearly fifty yards along a disused trench, dragging herself over the rubbish left behind, then happy at the success of her ruse, flew off and back to her little grassy home." Evidently the birds were too much occupied with their own struggle for existence to notice the bullets and shells, an interesting discovery to which several writers on the war have lately drawn attention.

Biology by Discovery. By E. GREEN and E. A. POTTER. (Dent. 5*s.* net).

Now that the importance of biological studies is gaining increased recognition in elementary and secondary schools, this carefully planned book is certain of a warm welcome from educationalists. To the general reader, too, who has neither the time nor the inclination to enter upon a course of detailed study, it is bound to be of interest. It is, we are pleased to note, infinitely more systematic and exact than the usual books on natural history; yet it avoids the necessarily formal treatment of the more advanced text books.

As an attempt to bridge the gap between childish simplicity and concentrated specialism it has achieved signal success. The text is broad in scope and intensely practical in its method. The directions for practical laboratory and field work are superior to those usually found in so-called "practical" handbooks, while the illustrations are all clear and good. It can be specially recommended to students preparing for the School Certificate examination.